THE

ELECTRICAL REVIEW.

VOL. XCII. JUNE 15, 1923. No. 2,377.

ELECTRICAL REVIEW.

Vol. XCII.] CONTENTS: June 15th, 1923. [No. 2,377.

	Page
Popular Electricity at Wembley	921
British Anxiety in China	922
New Commissioners for India	922
E.H.P. Steam Plant	922
British Standard Ratings	923
Municipal Electricity Supply—1922-23	923
The I.E.E. Summer Meeting	923
Export Sales Methods	923
Water-power Studies—III, by William T. Taylor	924
Notes on Ball Bearings, by W. R. Douglas Shaw	926
Overhead Wires and the Law	926
Problems in Telephony, Solved and Unsolved, by Prof. J. A. Fleming	929
Legal	930
Business Notes	930
Notes...	936
The Lancashire Electric Power Company (*illus.*)	938
An Electrically-driven Wire-rod Mill (*illus.*)	941
City Notes	946
Stocks and Shares	949
Market Quotations for Chemicals and Metals	950
Export Organisation, by Leon Gorini	951
A New Radio-Telephone Receiver (*illus.*)	952
Electricity Supply and Traction at Manchester	953
Electricity Supply at Shanghai (*illus.*)	954
Extra-high-pressure Steam Plant (*illus.*)	955
New Electrical Devices, Fittings, and Plant (*illus.*)	956
Parliamentary Notes	957
British Sales in Holland	957
Australian-built Turbo-alternators (*illus.*)	958
Correspondence—	
Multiple Circuits	958
"Situations Vacant"	958
Meter Readings and Multiplying Factors	959
Reviews	959
New Patents	960
Published Specifications	960
Contractors' Column ... ... Advertisement page xxviii	

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 6d.

The Oldest Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

Technical Editor: A. H. ALLEN, M.I.E.E. *Commercial Editor:* A. H. BRIDGE.

Joint Manager: E. A. GATEHOUSE, M.I.E.E., A.M.INST.C.E.

Joint Manager and Secretary: E. S. MIDDLETON.

Chairman & Managing Director: H. ALABASTER.

OFFICE, 4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEREAY, CENT., LONDON." Code, A B C. Telephone Nos.: Central 9260 and 9261.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

FOREIGN AGENTS:

AUCKLAND, N.Z.: Gordon & Gotch, Albert Street; Peter G. Tait, P.O. Box 392; R. Hill & Son, Matlock House, 33/34, Quay Street; Trade Publications Co., 302, N.Z. Insurance Buildings, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.

DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.

JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.

LAUNCESTON: Gordon & Gotch, Cimitiere Street.

MELBOURNE: Peter G. Tait, 90, William Street; Gordon & Gotch, Queen Street.

MILAN: Fratelli Treves.

NEW YORK: D. Van Nostrand, 8, Warren Street.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Ditta P. Maglione & C. Strini, 88, Via Due Macelli.

SYDNEY: Peter G. Tait, 273, George Street; Gordon & Gotch, Pitt St.

TOKYO: Maruzen Co., Ltd., 11-16, Nihonbashi-Tori-Sanchome.

TORONTO, ONT.: Wm. Dawson and Sons, Ltd., Manning Chambers; Gordon & Gotch, 132, Bay Street.

WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "London Joint City & Midland Bank, Newgate Street Branch."

POPULAR ELECTRICITY AT WEMBLEY.

FROM the information that has been published in our pages, readers will have gathered that the electrical engineering exhibits at the British Empire Exhibition will be large and impressive, demonstrating beyond all question the technical and productive capacity of British electrical manufacturers.

There is another and not less important part of the undertaking to which much thought has been devoted, but concerning which little has been written save by way of suggestion. We refer to the greatness of the opportunity for making a popular and educative electrical appeal to millions of people, and the most effective means for organising and planning the biggest effort of the kind ever made in these islands.

We are now in a position to outline the scheme which has been maturing in the minds of the authorities for some time past. We understand that necessarily prolonged deliberations in committee and subsequent preparation of suitable literature have delayed the issuance of particulars of the approved project until now.

It is designed that a great demonstration shall be made on behalf of the whole electric supply industry through the medium of the British Electrical Development Association. In brief, the scheme is the holding in a prominent position in the B.E.A.M.A. section (the top left-hand corner of the Machinery Hall to be precise) of a general display occupying a space of about 10,000 sq. ft. organised on behalf of the massed electric supply undertakings—municipal and company-owned—of the country, which will be invited to share the cost between them.

Domestic and small power electrical applications will be arranged to produce a general effect which will make an abiding mental association of electrical progress with ease and comfort, convincing hundreds of thousands of visitors of the social and industrial advantages that electricity can bestow. It is intended to show electrical service in abundant detail, and to carry out the conception to perfection will call for the co-operation of the plain practical man and the imaginative genius.

The proposal now being put before supply authorities is for a combined display of electrical applications of all kinds for the education and instruction of the user or potential user of electricity. The best productions of all makers will be presented in one place showing the relationship between the work of the electricity supplier, the manufacturer, the contractor, and the final service of the public. There will be suitably open to inspection all kinds of electrical appliances and devices, domestic and industrial, so that the class of service these can render will be immediately understood by the lay mind. The electric restaurant will be so designed as to show visitors the whole process of cookery carried out under ideal conditions.

The first essential for this undertaking is the collection of many thousands of pounds to enable the work to be organised on a large scale, impressive and popularly effective, making the Electrical Show the talk of all the cities and towns of the country and a feature which shall successfully compete for public patronage with the most alluring entertainments at the Exhibition.

Municipalities and companies responsible for our electricity supply systems are being approached on the financial aspect of the project, and every municipal councillor and company director should be provided with the explanatory literature which has been prepared by the B.E.D.A. for his information.

The co-operation of municipalities is being sought not only on the ground that electricity supply expansion will, as the national curiosity and interest are aroused and satisfied, benefit their undertakings, but also because the occasion affords them an opportunity for advertising, through their Town Development Departments, the resources of their districts. The suggestion is advanced that funds usually devoted to work of this kind may be diverted to the general display at the Exhibition until the close at Wembley. This point will, no doubt, be fully considered by councils which are anxious to bring home to the manufacturing community, and to the public generally, the cheap power and other industrial and residential facilities claimed for their areas.

So far as the municipal undertakings are concerned, it may be pointed out that these are authorised to contribute to the funds of the B.E.D.A. by the provisions of Section 30 of the Electricity (Supply) Act of 1919, so there need be no questionings on the legality of their action as there has been in respect of some past exhibitions. Electric supply companies, of course, are not troubled by such considerations, being completely masters in their own houses, and, in view of the fact that they are at present enjoying a period of prosperity, we believe that they will be ready to come forward handsomely with funds to invest in an undertaking which will bring them still larger profits from a resulting accelerated rate of increase in demand for electricity for all purposes.

The details of the combined display will be elaborated and announced in due course. At the moment the guaranteeing of the wherewithal is the work in hand, and we trust that everybody who ought to do so will use his influence to secure a speedy and generous response.

British Anxiety in China.

THE outrage on the Tientsin-Pukow railway at the beginning of May has filled many European and American minds with anxiety. It appears that fourteen of the captured are still detained under appalling conditions. No doubt our own and other Governments are doing what they can to secure their release, but cable dispatches have been received by electrical engineering and iron and steel manufacturers here calling for drastic action to be taken by the foreign Powers. The appeal was sent from Shanghai by representatives of a large number of British electrical and other engineering manufacturers with weighty names, who declare that unless such drastic action is taken "trade in China will soon be impossible." The cable calls for pressure to be brought to bear upon Parliament and the Foreign Office to give strong support to our diplomatic representatives in whatever action may be necessary to secure that the existing state of affairs shall be promptly remedied. At this distance it is far from easy for the average man to understand the importance of isolated events in the Far East, but in this particular case there is no justification for regarding the Tientsin-Pukow outrage as a local occurrence which can be settled by rescue and release and compensation. It is unlikely that this strong joint appeal would have been sent home to England were there not a general anxiety out there that the whole situation as affecting British representatives and their movements and operations, especially "anywhere outside treaty ports," is intolerable and is becoming increasingly unsafe. We hope that such Government measures will be possible as will speedily secure the release of the captured and will ensure the safety of travel and residence of British subjects. As an indication of the attention which is being given to the Chinese market by British manufacturers, we may add that the list of signatories to the appeal from Shanghai includes Beardmores, Babcock & Wilcox, Edgar Allen, of Sheffield, Allens of Bedford, B. I. and Helsby Cables, Callender's, the English Electric, the General Electric, W. T. Henley's, Mather & Platt, Metropolitan-Vickers, Bruce Peebles, C. A. Parsons and Co., British Thomson-Houston, Thornycrofts, Stewart and Lloyds, Frank Pearns, the British Electrical and Engineering Co. of China, the Associated British Machine Tool-makers, Rees-Roturbo, and others.

New Commissioners for India.

THE desires of the industrial and commercial community for the strengthening of the Government Trade Commissioner Service are being met in India by the appointment of Major R. W. Clarke to take up a new Trade Commissioner post at Bombay and of Mr. W. D. Montgomery Clarke as a second Commissioner at Calcutta to assist the Senior Trade Commissioner there. Major Clarke, who has been serving lately in the Department of Overseas Trade, was a railway and mining engineer in India for six years before the war; he served for nearly five year with the Forces, and in recent years has served on important Commissions in Europe. On Saturday last he left these shores for Calcutta, where he will remain in charge for a short time, proceeding to Bombay for the opening of his office there in October. Mr. Montgomery Clarke also spent ten years in India in various capacities, was with the Forces until 1919, and subsequently saw commercial service in Cochin. He leaves this country for India about the end of July. We bring these appointments prominently before our readers because it is essential, in order to give our Trade Commissioners an opportunity of contributing their best assistance to the expansion of British trade in this great market, that full advantage should be taken of their existence. We believe that our Trade Commissioners desire to be of real service, and electrical and engineering firms can test the accuracy of this statement by bombarding them with inquiries. This can be done either by post from offices at Home or by personal application at Calcutta or Bombay when their responsible travelling or local representatives are in need of information. We are not forgetting that it is up to our Commissioners to make their presence thoroughly well known in the districts where they are located. Public appearances and discreet fraternising in commercial communities can enable a Commissioner to keep British activities well in evidence and to cultivate a desirable co-operative relationship with Britishers.

E.H.P. Steam Plant.

IN many branches of engineering in recent years progress has been made far beyond the stages which had been reached before the war, and the prefix "super" has consequently been worked almost to death; however, its use would appear to be fully justified in connection with the Benson "super-pressure" steam plant, of which we give some particulars elsewhere in this issue, for at one bound the pressure at which the steam is generated is raised to 3,200 lb. per square inch. In the neighbourhood of that pressure, and a temperature of 706 deg. F. (the exact figures are not known with certainty), steam and water have the same density, and pass insensibly from one state to the other on the slightest change of heat content being made. The reason for the choice of this point, as explained in the article, is the absence of ebullition and therefore of priming, which has been a fruitful source of trouble to the pioneers of higher steam pressures. Although the pressure is lowered to 1,500 lb.

before the steam is used in a turbine, it is still enormous in comparison with current practice; perhaps this is best brought home by the fact that the main steam pipe for a 1,000-kW engine has a bore of only 1¼ in.

The thermal efficiency of the plant, which depends upon the initial temperature of the working fluid, is theoretically over 42 per cent.; in practice it is hoped to reach 22.3 per cent., which represents a marked improvement over the best results obtained on ordinary lines with steam. The system is still only in the experimental stage, but the fact that it is being tested on so substantial a scale ensures that if the results are satisfactory they will have a direct bearing upon the design of steam plant in the near future.

We are pleased to know that the invention, which constitutes a very bold step into untrodden regions, is of British origin, though we are at a loss to know why so full an account of it should have been given to an American contemporary in preference to the British technical Press.

British Standard Ratings.

The issue of the new B.E.S.A. specification No. 168/1923 for the rating of industrial motors and generators, on which we commented recently, has been welcomed by manufacturers of these machines, who claim that the official standards are now in accord with long-established British practice—allowing a temperature rise of 40 deg. C. at the rated normal load, with a margin for sustained overloads up to 25 per cent. for two hours. The old British specification—which never attained the rank of an accepted "standard"—provided for an ultimate limit of 50 deg. C. and no overload. The British Engineering Standards Association has few failures to mar its record of usefulness to industry, and this is perhaps the most noteworthy example of a miscarriage of its recommendations, which were founded upon the praiseworthy desire to secure international agreement.

In order to hasten the arrival at uniformity within our borders by bringing the new specification into general use, a number of manufacturers of motors and generators are distributing a circular explaining the position and emphasising the withdrawal of the B.E.S.A. specification No. 72/1917.

Municipal Electricity Supply—1922-23.

In commenting a short time ago upon the favourable results obtained by the electricity supply companies during 1922, we predicted that the municipalities would be able to produce equally satisfactory figures. Our confidence is being amply justified by the reports which are reaching us from the municipal undertakings for the year ended March 31st last. So far only one undertaking has reported a deficit; in all other cases the results of the previous year's working have been improved upon, in many cases to a remarkable degree. The two largest *English* undertakings—Manchester and Birmingham—whose results we record in this issue, are examples of this; in each instance the net profit has proved to be more than double that of 1921-22.

As in the case of the companies, it is not easy to ascertain to what extent reduced prices are to be thanked for the improvement, as against increased efficiency. It is noteworthy, however, that the overall thermal efficiency of the Stuart Street station of the Manchester undertaking rose from 11.88 to 14.82 per cent., while the average cost of fuel fell by 12s. 4d. a ton, representing a decrease of 35 per cent.

The results indicated have practically all been obtained in spite of reduced charges, but they appear to emphasise the fact that there is still scope for further reductions. We are convinced that nothing but good can result to the whole industry if far-sighted liberality is exercised in this respect.

The I.E.E. Summer Meeting.

Last week's Summer Meeting of the Institution of Electrical Engineers in Manchester, Liverpool, and North Wales, of which a further account will be found elsewhere in this issue, notwithstanding the extensive and rather exhausting programme, was voted a general success by one and all. Contrary to expectations, the weather was, on the whole, good; slight rain late in the afternoon of the first day interfered but little with the arrangements, although during the last day of the meeting the Clerk of the Weather evidently made a special effort to convince the visitors that there was no lack of water in the North Wales hydro-electric area. Under the circumstances, the North Wales Power Co.'s arrangements for the comfort of the visitors were specially appreciated, and only those who know the location of hydro-electric power stations can appreciate the trouble that the Aluminium Corporation, Ltd., must have been put to in entertaining so large a party.

Much is to be learned from such visits, even by electrical engineers, and a noticeable feature of all the tours was the enthusiasm with which manufacturers showed all—or shall we say nearly all—there was to be seen in their works; the handsome souvenir brochures distributed by many of them deserve careful reading.

Perhaps the day most eagerly looked forward to was Wednesday, when visits of inspection were paid to the Manchester Corporation's new electricity generating station at Barton and the Trafford Park works of the Metropolitan-Vickers Electrical Co., Ltd. The former has many noteworthy features, and the latter were impressive especially to those who went over them for the first time; but many of the other undertakings visited were of equal interest, demonstrating as they did the efforts that were being made to secure increased and more economical production.

By providing so many diverse attractions from which to choose each day, the organisers of the meeting provided alternatives to suit all tastes, and Messrs. A. S. Barnard and B. Welbourn, chairmen of the Centres, as well as the local hon. secretaries, Messrs. A. B. Mallinson, A. L. Green, and O. C. Waygood, are to be heartily congratulated on the manner in which they carried out the heavy task that was entrusted to them.

Export Sales Methods.

What is described as a unique method of selling machinery has been brought to the attention of the American Trade Commissioner in Johannesburg. While it may not be suited to all lines of industrial equipment, *Commerce Reports* suggests that it might be followed by more manufacturers interested in South African and other foreign markets. The American firm now using the method sends into the foreign field its export sales manager, who has sample machines shipped to him for use in the principal centres. First, an attempt is made to get into touch with a prominent user of the type of equipment, on a trial or demonstration basis, no attempt being made to sell the machine until after it has been running and has proved its utility and economy. In fact, this policy is adhered to so rigidly that the sale of a machine will not be permitted before one has been erected and the demonstration has been carried out.

The question of local agency is settled by placing it with a firm selling supplies to the local industry for which the machinery is intended. The attractiveness of such a sales method is obvious. Buyers make their purchases on the basis of actual accomplishment under their own working conditions, which, of course, vary in the different markets. Only machinery that is right and is suitable to local needs can be sold under such a policy. One of the most important features of the method is the confidence which is immediately built up in the minds of prospective buyers when they see that the manufacturer on his part has sufficient confidence in his product to send out machinery without any definite sales being in sight.

D

WATER-POWER STUDIES.—III.*

Stream Flow.

By WILLIAM T. TAYLOR, M.Inst.C.E., M.I.E.E., M.Am.Soc.C.E.

THE stage of a river or stream is usually taken as the height of the surface of the water in the river† or stream with respect to datum, zero, or bench-mark. For any particular site it is important that the information be based on the available power with respect to this datum or bench-mark; particularly on measurements of discharge made at high and low water stages at that site.

Usually it is unsafe to develop power for the maximum flow of the stream; many conditions indirectly influence the maximum and/or the most economical power development point. On the other hand, hydraulic works (the dam or weir in particular) are always laid out with the highest possible stream flow in mind.

At the present time, the ordinary minimum stream flow is usually taken as the safest basis upon which to draw up water-power estimates. In general, the more important problem is to determine the proper or the economical amount above the ordinary stream flow for which the development should be built. Numerous independent variables enter into the determination of this amount. The correct amount will depend, in no small way, upon the degree of insurance or continuity of supply justified by the conditions the particular project and the load, &c., offers. If absolute continuity of service must be guaranteed and must be included in the agreement for energy supply, then for such conditions, and, assuming little or no storage, uncertain facilities for dependable storage, and no possibility of interconnection with other plants, it would generally be advisable to take the ordinary minimum‡ flow and to use it in connection with the maximum load that can occur.

Records (showing over-estimation or failure) are available to prove that, in the investigation of stream flow, the engineer sometimes failed to apply a reliable run-off coefficient or failed to use the best suited method in estimating the annual run-off in the absence of gaugings, or he could not get reliable stream flow records extending over a sufficiently long and continuous period, or he was inclined to favour the amount of available power or rely too much on certain records of stream flow not exactly reliable and safe. In a subsequent article§ several methods will be given for estimating the run-off of a catchment in default of stream gaugings; these different methods should be referred to, as they deal with: (*a*) the rainfall percentage method; (*b*) the rainfall loss method; (*c*) the empirical formulæ method; and (*d*) the direct comparative method. Every year has its period of relatively low water with one or more days of least flow (perhaps total drying up), but the average rates of discharge during the low periods of some years, as well as the least daily discharge, are much greater than in others. These absolute minimum values are of great importance; their significance should not be overlooked by the investigating engineer, and they should be mentioned when preparing estimates and determining the amount of power available from the given catchment and stream.

*Previous articles in this series appeared in the ELECTRICAL REVIEW of February 2nd and 9th, and March 16th and 23rd, 1923.

†Throughout the text the word *stream* will be used in place of the two words *river* and *stream*.

‡The averages of minimum flow for the lowest two consecutive seven-day periods in each year, over a period of years.

§Water Power Studies V.—Rainfall and run-off.

Errata.

Page 444, *seventh line, left column.*—The word *in* should read *to*.

Page 446, *left column.*—*Fig.* 5 should read *fig.* 6.

Also, right column of page 446, in tabulation of examples, *h.p. loss per* 100 *ft. head* should read *h.p. loss per* 100 *cusecs.* For total gross h.p. 2,286, read 2,268; error in both cases is due to using coefficient .1143 instead of .1134.

For a stream, the wetted perimeter is taken as the length of the line outlining the bottom and sides. For a uniform flow the grade or slope line has a constant slope or fall which may be measured by the sine s of the angle of inclination, that is, $s = h°/L$; wherein $h° =$ head lost in length L. The hydraulic radius $R = A/w =$ cross-sectional area/wetted perimeter. For a stream, it is usual to take *mean* depth as area/width.

On streams fed mainly by ground water, the low-water flow is determined by the precipitation several months previously. The best ground water supply is usually found in regions of ample precipitation where both soil and sub-soil are of fine, sandy character and forest cover is absent. Clay soils retard percolation or seepage, and facilitate surface run-off. Deep, sandy soil and sub-soil will permit a large amount of percolation and will quickly carry the percolating water to depths from which it is safe against return by capillary action. Rock outcrops, muck, clay soil, and steep slopes assist in a rapid concentration of flood water. The determination of the amount of ground water and the water table is usually attended with doubt and uncertainty.

Methods for measuring stream flow are many and varied. At the present time the current meter method is the one most extensively used for the different flowage conditions and stream sections. With this method the most accurate results are obtained when the hydraulic section on which measurements are taken is selected primarily with regard to flowage conditions, *i.e.*, a stream with smooth sides and bottom, and the reach or section uniform for a sufficient distance both up and down stream to ensure a smooth flow and avoid turbulence; these flowage conditions are also very favourable to the use of and the accuracy of slope measurements. For the current meter method it is important that the current meter be calibrated before use and also after use, *i.e.*, calibrate the meter for straight-line flow and choose a reach or section so as to have the meter working under conditions where reasonably straight and smooth flow can be expected to occur for different stages of the stream. For the different channel conditions, the most satisfactory gauging methods to use are:—

Conditions of stream.	Gauging method recommended.
Small streams	Current meter or sharp-crested weir.
Open channels of uniform section ...	Current meter or rod float.
Narrow, deep and uniform section ...	Current meter, rod float, colour or brine method.
Wide and shallow streams	Current meter.
Deep and narrow streams	Current meter or chemical process.
Swift or turbulent mountain streams	Chemical process, and, perhaps, the current meter.

The methods for measuring stream flow can be divided into the following groups: (1) direct discharge methods; (2) mean velocity-area methods. The former (1) includes all methods whereby the total discharge is determined directly independent of any knowledge of the velocity or sectional area, and embraces such means as (*a*) weirs; (*b*) chemical gauging; (*c*) volumetric or bulk method; (*d*) gravimetric method. Of the four methods of measurement, the most reliable and one of the most used methods is by means of the weir, *i.e.*, a vertical obstruction placed in the stream bed containing a notch of either trapezoidal, rectangular or "V" form over which the water falls. The *standard* sharp-crested weir is the type used extensively in most countries. A *standard* type consists of a metal crest (free from rust) with a sharp right angle corner on the up-stream edge, a crest width of one-eighth inch and bevelled to an angle of 45 degrees

on the down stream face. Knowing the dimensions of the weir, the observation necessary for the determination of the discharge is the head or the depth of water flowing over the crest. It is important that the channel of approach be straight and uniform, and that the crest be carefully levelled. As in most other matters, the "personal equation" is an important factor; as an instance, if the head on the weir is not carefully measured, serious inaccuracy is sure to arise.

Another important method (applicable to streams and conduits) is the chemical process. This method consists of putting some chemical, usually salt, in the stream (or in the water conduit and penstocks) at a certain definite rate, and then at some other point down stream (or in the tail-race), after a uniform mixture has been effected, samples are drawn off and the degree of dilution is determined. In other words, if y lb. of salt be added each second to a stream whose discharge is Q cusecs and after a thorough mixture it is found that x lb. of water contains 1.0 lb. of salt, the total discharge Q will be approximately equal to $xy/62.5$; thus, $y/Q\ 62.5 = 1.0/x$.

The flow measurements of *group* 2 can be divided into the following:—

(A) Methods whereby the mean velocity of the entire stream can be determined directly by one operation, such as measurements by (*a*) slope determination; (*b*) colour or brine methods; (*c*) travelling screen; (*d*) orifice or nozzle methods; (*e*) Venturi meter, &c.

(B) Methods whereby the total cross-sectional area is divided into sections whose mean velocities, areas, and discharges are summed up to give the total discharge of the stream; these methods differ only in the manner of determination of mean velocity of the section, and they may comprise the use of one or more of the following means: (*a*) current meter; (*b*) rod float; (*c*) surface or sub-surface floats, of which (*b*) is one; and (*d*) Pitot tubes, &c.

One of the most common errors in the measurement of discharge Q is caused by erroneous soundings. Soundings should be taken close enough to indicate and include irregularities in the cross-section. At a number of points the depth should be taken and from these different depths the mean depth computed. To obtain the cross-section it is not sufficient to take the measurements at one point only, several cross-sectional areas should also be taken at intervals along the course or reach of the stream being measured. It is usual to plot all soundings for the same mean stage, then the hydraulic section is laid out to some convenient scale and divided into squares or sections; after the cross-section is accurately determined, it is laid off in vertical sections and enough point stations located on the centre line of each section to enable a consistent vertical curve to be plotted.

The *discharge of a stream* is commonly expressed as: $Q = AVk$ (cusecs); wherein A = cross-sectional area in square feet; V = mean velocity in feet per second; k = coefficient, varying under different channel conditions. In general, the coefficient will vary inversely with the slope or velocity or roughness, directly as the depth, and, for fairly narrow streams, directly as the width of the stream. The area A may be calculated by the *general* formula for discharge per second:—

$$Q = a_1 V_1 + a_2 V_2 + a_3 V_3 + \ldots . a_n V_n,$$

wherein $a_1 a_2 a_3$, &c., are the component parts of the cross-section, and $V_1 V_2 V_3$, &c., the mean velocity in each of these parts.

The *average* cross-sectional area A should always be used in the determination of Q. The discharge Q is a function of the cross-section A and mean velocity V. The final value of discharge Q is computed from the individual discharge measurements and curves made up from the corresponding mean velocities and the cross-sectional areas for each measurement and the gauge height h'; the latter should always be available, as the area A is usually determined by soundings with reference to the stage of the stream and the observed gauge heights. By taking measurements at many stages of flow a rating curve can be plotted; by means of this it is only necessary to read the gauge, compare the reading with the rating curve, and then locate on the diagram the discharge corresponding to the given stage. Such a diagram is very useful, and, slightly modified, it may also be used to indicate the power available at the given stage.

Many methods are in use for determining stream flow *velocities* by current meters and floats; some of these methods are:—

(*a*) By current meter, take the velocities at equal vertical intervals at about 12 inches or more, and obtain their arithmetical mean.

(*b*) Hold the current meter at each predetermined point for a sufficient time to allow the varying velocities of a cycle at that point to register. Under uniform velocity conditions the duration of time at each point should be not less than one minute. The top or sub-surface station should be just under the water surface, and the lower or bottom station should be as near the bottom of the stream as the meter will operate satisfactorily. The vertical velocities are then plotted and the areas planimetered in order to get the mean velocity, then a horizontal curve is plotted from the mean velocity values. By continuing the curves to the sides and bottom of the stream, the entire section can be considered in the determination of the quantity Q.

(*c*) By current meter, take the velocity at 0.6 of the water depth. By the use of this method with bottom and sides of smooth and uniform section for a sufficient distance both up and down stream (for normal stream flow of moderate depth) the use of a coefficient is unnecessary in the determination of the mean velocity. This method is, however, reliable over a wide range of conditions. In North America it is in common use.

(*d*) By current meter, take the velocity at 0.2 and that at 0.8 of the water depth and obtain one-half the sum. This method is used for general stream gauging. When very great accuracy is required, two current meters should be used, one for the method (*c*) and one for method (*d*). The degree of accuracy will depend on the ratio of width to depth and the velocity.

(*e*) By current meter, take the velocity at 0.2, 0.6 and 0.8 depth. The mean velocity can be obtained by *dividing* by four the sum of the measured velocities at 0.2 and 0.8 depth *plus* the velocity at 0.6 depth. The mean velocity can also be computed from the *approximate* formula:—

$$V = \frac{k\,(v' + v'' + v''')}{\frac{2 + v'''}{3}}$$

v' = surface velocity.
v'' = velocity at 0·2 of the depth.
v''' = velocity at 0·6 of the depth.
v'''' = velocity at 0·8 of the depth.
k = coefficient varying from 0·85 to 0·95 according to the depth, width and velocity.

(*f*) By current meter, take the velocity near the water surface and use from 0.80 to 0.95 of the result. The value of this coefficient will depend on the depth of the water, its velocity, and the nature of the bed of the stream. The point of observation should be from 6 inches to 12 inches below the surface, its proper location depending on the depth of the stream. This method is generally used in swift flowing streams and in streams during times of freshet.

(*g*) By current meter, take velocity at 0.5 depth. The *approximate* formula for mean velocity is: $V = v' \times 0.96$, wherein v' = velocity at mid-depth.

(*h*) By current meter, take velocity in the vertical line by uniformly lowering and raising several times the current meter throughout the range of water depth. This method may be used to determine the coefficients mentioned in the above methods.

(*i*) *By means of floats.* The different kinds of floats are surface, sub-surface, or a combination of the two, and rod floats. Nearly all surface floats are useless, as they give only the surface velocity, and with almost any wind blowing, the velocity cannot be measured with accuracy. Also, in general, the sub-surface float is unreliable, as it is easily caught by eddies and cross-currents which move it about. An *approximate* formula for average velocity is to multiply the surface velocity by 0.85. One of the most satisfactory surface floats is

the ordinary bottle, sealed up, with a weight placed in the bottom. The most satisfactory surface float is the *rod float*. The rod float is made of wood or metal tubing so weighted that, when placed in the water, the rod remains vertical with not more than a few inches of its length appearing above the surface. The mean velocity, by means of the rod float, is computed by the *approximate* formula: $v = v^{\circ}\ [1.0 - 0.116\ (\sqrt{D} - 0.1)]$ wherein v = mean velocity in vertical; v° = observed rod float velocity; D = proportion of depth not reached by rod. The mean or average velocity can also be *approximately* determined from the formula: $V = A\ (L/t)\ k$, wherein L = length in ft. measured; t = average time in seconds; k = coefficient = 0.75 to 0.85; A = calculated cross-sectional area.

(To be concluded.)

NOTES ON BALL BEARINGS.

By W. R. DOUGLAS SHAW, M.I.Ae.E., F.R.S.A.
(Hon. Secretary to the Anti-Corrosion Association.)

Although the object of providing ball bearings with lubricant is to protect the surfaces from corrosion and to lubricate the cages, lubrication is not necessarily the only precaution to be taken in particular circumstances.

Erosion caused by particles of dust and grit may be very destructive and easily mistaken for corrosive action. Curious effects, too, have been observed in connection with electrical machinery. For example, a current as low as 1 amp. per sq. in. has been found to corrode the housings of bearings in electric vehicles, and the effects of even smaller currents are not negligible. It is not the actual current that destroys ball or roller bearings, but the effect of breaking the current, as occurs when the bearings become worn. The design of special shunting devices has been proposed for the elimination of this form of corrosion in electric vehicles.

In instrument work very small ball bearings have proved unsatisfactory. They do not run smoothly, presumably because the proportional accuracy of the balls and the races is not high enough. On the other hand, where the load exceeds 1,000 grammes, ball bearings are a source of less friction than even conical pivots. Moreover, they are more resistant to shock and wearing forces generally. For heavily-loaded rocking pivots, a ball and hemispherical socket bearing, with the two main components separated by a row of small balls, is more satisfactory than a pivot resting in a socket. Vibration reduces considerably the static friction of a pivot or bearing, and cases have been noted in which the reduction amounted to as much as 95 per cent.

In internal-combustion engine practice, crankshaft ball bearings have promoted an appreciable reduction in bearing friction, particularly in the case of high-speed engines. They are perfectly reliable in this capacity, but with fluctuating loads are inclined to be somewhat noisy. As bearing friction represents but a small percentage of the internal resistances of an engine, no great advance in efficiency is likely to accrue from their use, and the application of ball bearings to crankshafts should only be regarded as a minor refinement in design.

Any pure high-grade mineral oil is a suitable lubricant for ball bearings. It should be free from resin, salt, and, of course, mineral acid (now rarely found in refined oil, although employed in the refining process). The sulphur content should not exceed 0.03 per cent., and any free alkali or ash present must not be more than the merest trace. In the case of a grease, care must be taken that it contains no abrasive particles, such as sand. For transmission work, housings may be packed with grease and left without further attention for at least three months.

OVERHEAD WIRES AND THE LAW.

[BY A LEGAL CONTRIBUTOR.]

Amongst the legal questions which trouble the mind of him who desires to generate electricity on his own account, and supply energy either to outlying buildings on his own land, or to his neighbours, there is none more important than that which arises in relation to the use of overhead wires. The use of this economical means of transmitting energy is hedged about with certain legal restrictions which are to be found partly in the common law, and partly in a series of statutes in which the Legislature has sought to meet the varying needs of those concerned with the supply of electricity.

"Common law" upon the subject may be stated to be that anyone who stretches a wire across the land of another without leave or licence is guilty of a trespass. This may appear to be a technicality; but it is a fundamental principle that a freeholder owns his land *a cælo usque ad inferos*. An old judge once declared—and he was right in so declaring—that to pass over a man's land in a balloon is to commit a trespass! Again, if wires are stretched along or across a street or highway, the person who puts them in that position does so at his peril, for it may be that the highway authority is the freeholder of the road, and in any Court the public who are using the road are entitled to be protected against falling wires. But there may be circumstances in which a man owning land on either side of a highway has the right to stretch wires across it. In such a case he owns the surface of the "hard high road," and so long as the right of the public to pass and repass along it is not interfered with, he cannot (at common law) be prevented even by the highway authority from stretching his wires, whether they be for the purposes of telephone, telegraph, or the transmission of energy.

By a process of evolution the Legislature has gradually placed restriction upon the use of overhead wires. Prior to the Electric Lighting Acts, the matter never assumed any importance, except in relation to telephone and telegraph wires with which we are not greatly concerned. The first Electric Lighting Act (1882), however, imposed restrictions upon the use of aerial cables. By S. 14 of that Act: "Notwithstanding anything in this Act or in any Act incorporated therewith, the undertakers shall not be authorised to place any electric line above ground, along, over, or across any street, without the express consent of the local authority, and the local authority may require the undertakers to forthwith remove any electric line placed by them contrary to the provisions of this section, or may themselves remove the same, and recover the expenses of such removal from the undertakers in a summary manner; and where any electric line has been placed above ground by the undertakers in any position a Court of summary jurisdiction, upon complaint made, if they are of opinion that such electric line is or is likely to become dangerous to the public safety, may, notwithstanding any such consent as aforesaid, make an order directing and authorising the removal of such electric line by such person and upon such terms as they may think fit."

This section, however, was apparently found not to impose restrictions on the use of overhead wires. Accordingly it was further provided by S. 10 (*b*) of the Schedule to the Electric Lighting (Clauses) Act, 1899, that "The undertakers shall not, without the express consent of the Board of Trade, and, where the local authority are not themselves the undertakers of the local authority also, place any electric line above the ground except within premises in the sole occupation or control of the undertakers, and except so much of any service

line as is necessarily so placed for the purpose of supply."

In the County of London Orders, and under the London Electric Supply Acts, 1908, S. 15 (2), the consent of the County Council and of the Board of Trade is required, while in some of the Power Acts it is provided that in the case of rural authorities their consent shall not be unreasonably withheld, the Board of Trade being authorised to decide any difference (see *e.g.*, The Somerset and District Electric Power Act, 1903, S. 48).

Even where the necessary consents are obtained, the works are subject to the regulations prescribed by the Board of Trade in reference to aerial lines. Further, the undertakers cannot carry such lines over land not dedicated to the public use without the consent of the owner of such land. In doing so, they would, as we have seen above, be guilty of a trespass. Thus, in the case of "Levy *v.* National Telephone Co., Ltd.," the plaintiff brought an action against the company for damages for trespass by stretching wires over his house, and also for an order that the defendants should undertake the removal of the wires. The defendant company, in resisting an application for interim injunction, urged that some of the wires had been over the house in question for 13 years, and that the plaintiff had only been in occupation of it for a short time; and that there was no danger to the plaintiff's house in allowing the wires to remain until the trial. Day, J., granted an interim injunction directing the defendants within two months to remove their wires. On appeal this decision was affirmed by the Court of Appeal. (See *The Times*, December 18th, 1897.)

Nor does the consent or approval above mentioned excuse the undertakers from the consequences of neglect or falling wires. For instance, in "Watson *v.* Sunderland Corporation" (cited in "The Law of Electric Lighting," by Shiress Will (4th edn.), at p. 100), in an action for damages for an injury suffered by the plaintiff through the fall of a "live" overhead wire, the plaintiff proved the fall of the wire and the injury. The defendants submitted that there was no evidence of negligence, the system having been inspected by the Board of Trade, and weekly by the defendant's employés. The County Court Judge left the case to the jury, who found negligence. On appeal, the Divisional Court held that the Judge was right in allowing the case to go to the jury.

The law, however, cannot be regarded as fully stated unless one deals with the rights of persons supplying electricity otherwise than in accordance with the provisions of a special Act. In this respect the person who supplies electricity privately was formerly in a better position than a supply authority. It was held in "Finchley Electric Lighting Co. *v.* Finchley Urban District Council" (1903), 1 Ch. 437, that where a company was supplying electricity privately it could not be prevented by a highway authority from suspending wires over a highway, having previously entered into an agreement with the frontagers on either side of the road in order to be allowed to fix the posts necessary for the suspension of the wires. The right there asserted is not, however, very likely to be of much more than academic interest in the future, having regard to the fact that the supply of electricity otherwise than by a supply authority was virtually taken away in 1909. Thus, by S. 23 of the Electric Lighting Act, 1909, "Where in any area a local authority, company or person is authorised to supply electricity under Act of Parliament or under licence or Provisional Order granted under the Electric Lighting Acts, it shall not, after the passing of this Act, be lawful for any other local authority, company or person to commence to supply or distribute electricity within the same area unless such supply or distribution is authorised by Act of Parliament, or by licence or Provisional Order granted in terms of the Electric Lighting Acts. Provided that this section shall not prevent any company or person from affording a supply of electrical energy to any other company or person where the business of the company or person affording the supply is not primarily that of the supply of electrical energy to consumers.

"Provided also that this section shall not prevent any company, who, at the passing of this Act, are empowered by their memorandum of association to generate electrical energy from affording a supply to a railway company for purposes incidental to that company's undertaking other than the conveyance of public traffic."

The suspension of overhead wires in any position—even on private land—was made subject to certain other statutory regulations which are of considerable importance.

By virtue of the Electric Lighting Act, 1888, S. 4 (1), wires can only be so placed in accordance with the regulations of the Board of Trade. Again, in London, their use is subject to the provisions of the London Overhead Wires Act, 1891. With regard to urban districts, the Public Health Acts Amendment Act, 1890, confers powers upon urban authorities to make by-laws for the prevention of danger or obstruction to the public from posts, wires, tubes, or any other apparatus stretched or placed above, over, along, or across any street, whether before or after the adoption of the Act for the purpose of any telegraph, telephone, lighting, railway signalling or other purpose.

These by-laws are not to take effect unless confirmed by the Board of Trade. It is necessary to observe that the Act of 1890 is an adoptive Act and is of no force until adopted. Moreover, the Act does not extend to any works of any undertaker within the meaning of the Electric Lighting Acts, 1882 to 1888, to which the provisions of those Acts apply.

It remains to consider the provisions of the Electricity (Supply) Act, 1919, which relate to overhead wires. By S. 21 of this Act, where the consent of the Board of Trade is obtained to the placing of any electric line above ground in any case, the consent of the local authority shall not be required, anything in the Electric Lighting Acts, or in any Order or special Act relating to the undertaking to the contrary notwithstanding. The Board of Trade, however, before giving its consent, must give the local authority an opportunity of being heard.

Section 22 of the Act of 1919 deals comprehensively with the subject of wayleaves. No one can read it without realising that, by 1919 at any rate, our legislators had become aware of the fact that there is nothing so very dreadful after all in a few overhead lines. They do not, save to a very trifling extent, mar a landscape or a view; they are not, except in very rare cases, a source of danger to man or beast. Objections put forward in the past by persons asked to grant wayleaves for wires were usually absurd. One recalls the case of the officer of a telephone company calling at a house to ask that leave might be granted to stretch a wire across the garden. The infuriated owner threatened to kick this servant of the company out of the house. To which the zealous man replied: "If I take the kicking, will you give me the wayleave?" He got ready to be kicked, when the householder, appreciating the humour of the situation, gave him all he wanted.

Not that there are *no* circumstances in which compensation of some kind should be paid for the grant of wayleaves. Realising that there may be cases of hardship, the Legislature has very wisely made provision for the payment of compensation.

By S. 22 of the Act of 1919, a joint electricity authority or any authorised undertakers may place any electric line above ground across any land other than land covered by buildings or used as a garden or pleasure ground in cases where the placing of such lines above ground is otherwise lawful; and where any line has been so placed across any land, they may enter on the land for the purpose of repairing or altering the same.

All this is subject to a proviso—the terms of which will be dealt with presently—but it is important to notice that the right to suspend wires is virtually limited to

agricultural and other land which "is not covered by buildings or used as a garden or pleasure ground." So far as law of this kind is concerned, the law remains unaltered by the Act of 1919. The reference to "cases where the placing of such lines above ground is otherwise lawful" is a little obscure. It obviously cannot mean that wires may not be placed against the will of a landowner, because the proviso shows that a landowner may be compelled to grant a wayleave on reasonable terms.

Lines over Railways, Canals, and Docks.

The power to place overhead lines conferred by S. 22 of the Act of 1919 includes power to place them across any railway, canal, certain navigation docks or harbours, subject to the rights of the owners thereof, and to certain special conditions. Thus, in the case of lines *across* railways, certain sections of the Electric Lighting (Clauses) Act, 1899, are to apply, without prejudice to any protection given to the railway companies by the Electric Lighting Acts and the Act of 1919, as though the lines were placed or proposed to be placed in accordance with a Special Order under the Act of 1899. The sections of that Act referred to above are those which require (*a*) due notice of the proposed works to be given; (*b*) compensation to be paid in certain cases; (*c*) that the works or working of the railway, &c., shall not be interfered with; and (*d*) that reasonable precautions shall be taken to prevent telegraphic and telephonic wires from being injuriously affected. With regard to lines proposed to be suspended *along* a railway, the proviso to S. 22 does not apply; and if the undertakers or joint electricity authority do not come to terms with the railway company, the matter may be referred to the Board of Trade, which may either decide that the lines shall not be so placed or refer the matter to the Railway and Canal Commissioners. That body may direct that the line shall be permitted upon pecuniary terms, or may cause an inquiry to be held.

The following is the substance of the proviso to the section. It is enacted that before placing any line across land, the joint electricity authority or undertakers shall serve on the owner and occupier of the land notice of their intention, together with a description of the nature and position of the lines proposed to be so placed; and if within 21 days they do not grant the wayleave, or impose terms which are objected to, the line cannot be placed in position without the consent of the Board of Trade. The Board, however, after giving all parties concerned an opportunity of being heard, may, if it thinks it just, give its consent either conditionally or upon such terms as it thinks just. In deciding whether to give or withhold its consent, or to impose terms or conditions (including a condition that some portion of the line shall be placed underground), the Board must, among other considerations, have regard to the effect (if any) on the amenities or value of the land of the placing of the line in the manner proposed.

It is reasonably plain that in the exercise of the powers conferred by this section, the Board of Trade might insist upon a proper rent being paid for a wayleave. It is also obvious that the Board may compel a recalcitrant landowner to do what is reasonable.

A few words should be said as to liability for damage caused by falling wires. Our knowledge of the liability of those whose wires fall about and injure people must, of necessity, be largely derived from a study of the law relating to tramway companies, and it may be convenient to review some of the cases in which the liability of these bodies has been considered.

In the first place, it may be stated that by the Tramways Act, 1897, S. 55, which applies to every tramway company, it is provided that the promoters or lessees of a tramway (as the case may be) shall be answerable for all accidents, damages, or injuries happening through their act or default or through the act or default of any person in their employment by reason or in consequence of any of their works or carriages, and shall save harmless all road and other authorities, companies or bodies collectively and individually, and their officers and servants from all damages and costs in respect of such accidents, damages, and injuries.

The above provision prevents a tram company, when sued by a person who has been injured by a falling trolley wire, from raising the defence that they are protected from actions for negligence owing to the fact that they work under statutory powers. This was made clear in a number of accident cases. For instance, in "Sadler *v.* South Staffordshire, &c., Steam Tramways Co.," 1889 (23 Q.B.D. 17), it appeared that an accident was caused by the company's car which ran off the line at a point where that line joined that of another system, over which the company had running powers. It ran off the line owing to a defect in the points at the junction, but it was not clear whose duty it was to repair the points. It was held that in any event the owners of the car were liable, because their statutory powers did not extend to authorise their running along the highway on a track which was in a defective condition. Again, in an Irish case, a tramway company was held liable for injuries caused by the worn and slippery condition of its track.

Where trolley wires are installed, and there are no guard wires above them, the breaking of a telephone wire sometimes makes contact with the trolley wire. The result may be that serious injury is caused by electric shock. In these circumstances it appears, upon the authority of a County Court Judge, that responsibility does not rest with the tramway company. In "Bedworth & Son *v.* The National Telephone Co.," an action was brought against the company for the price of a horse killed by an electric shock. It appeared that a broken telephone wire which fell on the horse had short-circuited a trolley wire belonging to the South Staffordshire Tramway Co., which was joined as defendant. The judge held that the telephone company was liable, as it had been guilty of a trespass in allowing its wire to touch that of the tramway company, and he made it responsible in damages.

[It will be understood that the powers of the Board of Trade, referred to in this article, are now exercised by the Ministry of Transport.—Eds. Elec. Rev.]

Permalloy—a New Magnetic Alloy.—In the *Journal of the Franklin Institute* for May an account is given of an alloy of remarkable magnetic properties, by Dr. H. D. Arnold and Mr. G. W. Elmen, of the Research Laboratories of the American Telephone and Telegraph Co. and Western Electric Co., Inc. It consists of approximately 80 per cent. nickel and 20 per cent. iron, and has a permeability at low field strength many times greater than any hitherto known. It is anticipated that its adoption will effect "a revolutionary change in submarine cable construction and operation," and equally important advances in other fields. The proper heat treatment of the alloy is of the utmost importance; the rate of cooling from just above the magnetic change-point to about 300 deg. C. is a controlling factor. Each size and shape of sample requires its own special heat treatment, and changes in composition also call for different treatments. Curves given in the article indicate that with $H=0.01$, μ is for Armco iron 250 and for Permalloy 13,000; with $H=0.03$, μ for iron is 270 and for Permalloy 33,000, whilst at $H=0.04$ the permeability of the latter is enormously increased. But with values of H between 10 and 100 the B—H curve of Permalloy is a straight horizontal line at $B=11,000$. One curve shows a maximum permeability for Permalloy of 87,000 ($B=5,500$), but this, it is stated, is not exceptionally high. Various other interesting physical properties have also been observed, of which further particulars will be given in a later issue.

United States Electric Vehicle Market.—The electric vehicle market continues fairly active. More than 70 electric trucks are reported to have been sold in the Metropolitan district last month. A New York department placed an order for 14 and a Newark store bought 10 trucks. The National Electric Truck Show is being held from June 2nd to 9th. The New York Electrical League is sponsoring a movement for the "motorisation" of commercial traffic in New York City. The work of the league is being concentrated primarily upon the introduction of electric trucks for making all light goods deliveries. Exports of electric trucks and passenger cars during March totalled 16 (valued at $26,239) against 40 (valued at $57,584) in March, 1922.—*Reuter's Trade Service* (New York).

PROBLEMS IN TELEPHONY, SOLVED AND UNSOLVED.

The Fourteenth Kelvin Lecture.

By Prof. J. A. FLEMING, M.A., D.Sc., F.R.S., Hon.M.I.E.E.

(*Abstract of lecture delivered before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

DURING the last fifty years a large amount of research work has been done in determining the aerial wave energy per square centimetre per second which must be passing at a certain frequency in order that the ear may just perceive it as an audible sound, or, alternatively, a sound of a certain pitch and loudness.

The results showed how extremely small is the amplitude of periodic motion of an air particle which can produce a just audible sound. A length of 10^{-8} cm. is called 1 Angström unit (A.U.); the length of a wave of yellow light is about 5,000 A.U. and the diameter of a molecule about 1 or 2 A.U. The maximum displacement of the air particle in the above case was only 8 A.U., or about 1/600th of the length of a wave of yellow light.

Approximately speaking, we may say that at a frequency of 256 the ear detects as sound a periodic change in air density of one hundred-millionth of an atmosphere, an amount equal to the air density in a space exhausted to a very good vacuum. Also we appreciate an amplitude of motion of an air particle of one or two millionths of a millimetre and an energy stream of one to three micro-ergs or so per square centimetre per second.

Lord Rayleigh came to the conclusion that the ear had a maximum sensitivity at a frequency of about 1,000. Some recent researches have enabled this matter to be more fully explored. It is abundantly clear that the human ear possesses a well-marked supersensitivity to sounds of certain frequency. One of these regions generally lies within the limits 700 to 1,000 p.p.s. and another between 1,500 and 2,000 p.p.s., and some observers indicate a third region about 3,500 to 4,000 p.p.s. There are, however, considerable variations in normal ears in this respect. The ear sensitivity diminishes very rapidly as the frequency rises much above 4,000 or 5,000 p.p.s.

H. Fletcher and R. L. Wegel, of the American Telephone and Telegraph Co. and the Western Electric Co., U.S.A., constructed a particular form of artificial telephone line by which the current passing through the receiver could be weakened in an exactly known ratio. As a means for absolute calibration they used a condenser transmitter. This instrument is an improvement and modification of Dolbear's electrostatic transmitter. It consists of a fixed, solid, perfectly flat plate in front of which and parallel to this but about one-thousandth of an inch, or less, apart is held a thin, flexible, tightly strained steel disk. The thin and thick plates are insulated from each other and form an air condenser. If an alternating potential difference is applied to the plates the flexible plate vibrates and emits a musical sound.

If, on the other hand, the plates are kept charged by a battery through a high resistance, and if the flexible plate is caused to vibrate by sound waves, the capacity of the condenser is periodically varied and hence the potential difference at the ends of the resistance also varies. This small varying potential difference can be amplified by thermionic valves and measured on a suitable thermo-electric voltmeter.

Hence the condenser transmitter can be calibrated by operating on it with known pressure variations and then used to produce sounds having known condensations and frequencies. There are great individual variations and those who are not usually called deaf may require a variable pressure up to more than 0.1 dyne per cm^2 at 1,000 p.p.s., whilst those who are deficient in powers of audition may require even from 1 to 10 dynes per cm^2 to hear the sound. The condenser transmitter also enables us to measure the energy conveyed across unit area per second by air waves of the speaking voice.

The human vocal organs, considered simply as an energy-translating device for the production of speech-wave energy, may have small efficiency in the technical sense of the term. The possible improvements in telephony are very closely dependent upon a knowledge of the nature of speech sounds and of the operation of the ear in appreciating them. When, by means of apparatus which transmits speech sounds without distortion, but with amplitudes increased or diminished in exactly known ratios, the amplitude is changed in the ratio of 2.71828 to 1, this is called reduction by 1 *napier*, since the above numeric is the base of the Napierian system of logarithms. If it is reduced in the ratio of $(2.71828)^n$ to 1, this is called reduction by n napiers. If we begin with a just audible speech sound, which corresponds to a variable air pressure of about 0.001 dyne per cm^2 (r.m.s. value) for sounds of frequency about 1,000 p.p.s., and if we then increase the amplitude by about 7 napiers, which brings the r.m.s. pressure to about 1 dyne per cm^2, since $(2.71828 \ldots .)^7 = 1,096$; we shall have a sound the loudness of which corresponds to the maximum articulation as judged by the percentage of correctly heard test-syllables transmitted. If the amplitude is increased still more the articulation falls off again. The ear is "deafened" by very loud speech; hence, there is a certain amplitude which gives the maximum of telephonic speech, articulation or intelligibility. By means of filters, which are artificial telephone lines constructed with inductive resistances in series and capacities in parallel, or *vice versa*, it is possible to attenuate very rapidly speech currents of a certain range of frequency either above or below certain selected limits. The results of filtering on telephonic speech transmission are very remarkable. According to the researches of Harvey Fletcher, Crandall, and Mackenzie a filter which cuts off all currents of frequency below 500 p.p.s. stops 60 per cent. of the speech energy, but only 2 per cent. of the articulation. This means that the speech is greatly decreased in loudness, but not much in clearness or intelligibility. On the other hand, a filter which cuts off all frequencies above 1,500, eliminates only 10 per cent. of speech energy, but reduces the articulation by 35 per cent. This means that the speech is not much reduced in loudness, but is very reduced in clearness. A filter which cuts off all frequencies above 3,000 p.p.s. has as bad an effect on articulation as one which cuts off all below 1,000 p.p.s.

Some speech sounds, such as the vowels u, o and e have characteristics carried by frequencies below 1,000, but the fricative consonants denoted by the letters i, z and th have their specific qualities conveyed by high-frequency harmonics and are greatly affected by cutting off frequencies above 3,000 p.p.s. The sounds denoted by the letters f, v and th are most difficult to hear and are responsible for 50 per cent. of the mistakes of telephonic interpretation. Their current articulation seems to depend on the transmission of harmonics of very high frequency. The general conclusion is that any telephonic apparatus designed for good speech transmission must transmit with equal efficiency and without distortion sounds of all frequencies from 100 to 5,000 p.p.s.

The poor transmission over ordinary telephonic circuits of certain consonants, such as f, v and th, is responsible for much difficulty, especially in the case of the names of digits such as *five*, *nine* and *three* in calling numbers.

If we call to mind the very distinctive qualities of individual human voices, even when pronouncing the same words, and the manner in which these tones can express emotions, feelings, or personality, all of which must be represented physically by minute differences in wave-form, we realise that the human ear is indeed one of the marvels of creation in its amazing powers.

When we consider the very complicated nature of our vocal or speech organs, as well as the training and practice necessary for their efficient use, and the parts played by the larynx, oral cavity, lips, tongue and teeth in speaking, we find reason for great surprise that the mere vibrations of a small flexible disk, such as the iron diaphragm of a Bell receiver, can impress upon the air, vibrations of the highly irregular wave-form necessary to reproduce speech sounds.

The fundamental frequency of vibration of a circular diaphragm clamped all round the edge is nearly equal to 1¼ times the ratio of its thickness to its area, multiplied by the velocity of sound in the material. The diaphragms of Bell receivers are usually made of "Stalloy" containing 2.75 per cent. of silicon, and are about 5.0 cm. in effective diameter and 0.025 cm. thick. The ratio of thickness to area is then 1:785. The velocity of sound in steel is about 4,710 metres per second and hence the natural frequencies of the diaphragm should not be far from 942 p.p.s.

For a steel diaphragm of thickness t and diameter d cm. the above rule approximates to $900{,}000\ t/d^2$. Hence, for a diaphragm 1/40 cm. thick and 5 cm. in diameter it gives the fundamental rate of vibration $n = 900$. These dimensions have been arrived at by trial and give a frequency not far from 800 p.p.s., which is generally taken as a kind of mean frequency for speech waves.

A. E. Kennelly and H. O. Taylor have shown that when a certain Bell receiver is traversed by an alternating current of 2 milliamperes with frequency considerably removed (say, by 20 per cent. or more) from the resonance frequency of the diaphragm, the amplitude of motion of its centre is found to be about 0.5 micron—that is, 1/20,000 cm. or less. This is about equal to the length of the wave of light in the middle of the visible spectrum, *viz.*, about 5,000 A.U. If the frequency is gradually brought up to the resonance frequency of the diaphragm, the amplitude of motion would be increased 15 or 20 times, say from 7 to 10 microns. Lord Rayleigh found for a certain receiver that the amplitude of motion of the diaphragm when producing a just audible sound of frequency 256 was 6.8×10^{-8} cm, or only about 7 A.U. P. E. Shaw, taking the amplitude of the air particle for the just audible sound to an expectant ear to be unity, found that the amplitude for a non-expectant ear must be increased to 7 or even 70, for a

very loud sound to 1,400, and for an overpowering sound to 7,000.

Thus it appears that the amplitude of motion of the air particle near the mouth of a speaker in a conversational tone is about 100 A.U. or 1/100,000 mm, and the amplitude of motion of the centre of a telephone diaphragm when producing a speech sound just comfortably heard by a normal ear is about 1/20,000 mm. An important matter is the shape of the diaphragm as it vibrates.

Speaking very roughly we might say that a Bell telephone receiver used in ordinary telephonic conversation is taking in power electrically about equal to 1 milliwatt, and is giving out power in the form of speech air-waves about equal to 1 microwatt. It is an extremely inefficient machine for the transformation of energy and far from perfect in its articulalation as a speech-producing appliance. The inefficiency of the Bell telephone was pointed out many years ago by H. Abraham, who deduced from certain measurements an acoustic efficiency of 1 part in 700 for a certain receiver at a frequency of 200 and a current of about 3.3 mA.

Here, then, is the chief unsolved problem of modern telephony, *viz.*, the invention of a receiver acoustically more efficient than the present type of magneto receiver, but it is difficult to see how any great improvement in efficiency can take place without radical departure from the fundamental principles of Bell's invention.

The only forms of practical receiver for telephony which have so far presented themselves as just possible alternatives to the electromagnetic or Bell type are those depending (i) upon thermal actions, (ii) on electrostatic attraction, and (iii) upon variations in the friction or adhesion of certain material, produced by the action of small currents or differences of potential.

The whole phenomena has during the last two years been very carefully re-examined in the electrical research laboratory at University College, London, by Mr. H. M. Barlow, and the results of his work will before long be made known. In all these methods there are possibilities of constructing a telephone receiver which may perhaps be found to have greater acoustic efficiency than the present types of Bell receiver.

The energy-transforming efficiency of the microphone transmitter has not been made the subject of so much experimental investigation as that of the Bell receiver. It would be very advantageous to get rid entirely of the necessity for a diaphragm; hence the new glow discharge microphone of Dr. Phillips Thomas of the Westinghouse Electric Co., of America, in which the speech air waves directly modulate an electric discharge current, is a distinct advance and is said to have been used for some time with marked success as a broadcasting transmitter in the United States.

(To be concluded.)

LEGAL.

The Banque Marmarosch Blank & Co. (Bucharest) and Joseph Fermo (Paris) v. Marconi's Wireless Telegraph Co., Ltd.

Mr. Justice Romer, in the Chancery Division on June 7th, delivered judgment in this action.

Plaintiffs' claim was to recover £8,500, and it arose out of a deal in Rumanian Treasury Bills. His Lordship said Mr. Fermo wished the defendants to take up £100,000 of these bills, and Mr. Godfrey Isaacs, on behalf of the defendants, agreed to undertake the business if the plaintiff bank would guarantee the discharge of the bills at a date not later than March 20th, 1922, and would pay to them a special bonus of £2,500. He found as a fact that under the arrangement the defendants were to buy the bills for £86,000, and the bank was to guarantee the defendants payment of £100,000 for the bills on March 20th, 1922, and £2,500 by way of bonus if the bills were not discharged in March, 1921.

The bank, said his Lordship, contended that if they had to pay the £100,000 with the bonus in March, 1922, the defendants were to hand over to them any interest or discount that they might receive from the Rumanian Government. The latter did not discharge the bills in March, 1921, and the defendants obtained 8½ per cent. interest on them upon the renewal for a further year. It was to compel the defendants to pay to them this £8,500 that the plaintiffs were now suing. They claimed that they had been substituted for Mr. Fermo in all rights he had, but he held that when they were repaid the £102,500, they were not entitled to have handed back to them the £8,500. The action failed and would be dismissed with costs.

County of London E.S. Co., Ltd., v. Weiner.

In the Mayor's and City of London Court, on June 5th, before Judge Shewell Cooper, the County of London Electric Supply Co., Ltd., sought to enforce payment of £22 12s. 8d. due from A. Weiner, tobacconist, for electric current supplied to one of his shops at Putney Hill. Defendant said the business was not his, but his wife's, and he helped her. At present he had not a penny in his pocket.

Mr. Butler said that plaintiffs had tried levying an execution on defendant's goods, but they were claimed by the wife.

Judge Shewell Cooper ordered defendant to pay 10s. in 14 days or be committed in default. If he could not pay he could apply to the Court again.

BUSINESS NOTES.

The Electrical Review Index.—Special Notice.—It is our intention to resume the publication of our half-yearly index free of charge to those who require it for binding purposes or wish to retain it for special reference. It is essential in order that we may know the number of copies that will be needed to meet all reasonable requirements that application for the Index to Vol. XCII (for the half-year ending June, 1923) should be made at once to The Publisher, Electrical Review, 4, Ludgate Hill, London, E.C.4. We shall make special provision for colonial and other overseas subscribers, but we shall be glad if they will notify their wants by the first mail leaving after the receipt of this announcement.

Bankruptcy Proceedings.—Albert William Verity, 10, Peach Street, Bradford, electrician, lately trading in co-partnership with another as Verity and Lee, 143a, Leeds Road, Bradford, electrical contractors.—The first meeting of the creditors of the above was held on June 5th at the Official Receiver's office, 12, Duke Street, Bradford. According to the statement of affairs the liabilities amounted to £39, against assets of £17. The case, being a summary one, was left with the Official Receiver as trustee of the estate.

T. G. Slater (Slater Bros.), electrical engineer, 25, Dickinson Street, Manchester.—First meeting June 19th, at the Official Receiver's offices, Byrom Street, Manchester. Public examination July 13th, at the Court House, Manchester.

G. W. Endall (Endall & Co.), electrical, mechanical and automobile engineer, Canal Motor Works, Canal Bridge, Church Street, St. Helens. Trustee, F. T. P. Deyes, 51, North John Street, Liverpool, released May 5th.

J. G. Macmillan, electrical dealer, sole proprietor of the Glasgow Electrical Supply Co., 138, Bath Street, Glasgow. Public examination June 15th, at the County Buildings, 70, Hutchinson Street, Glasgow. Meeting of creditors July 5th, at 53, Waterloo Street, Glasgow.

John Harris, Dugdale Street, Nuneaton, electrical and general engineer.—This debtor came up for public examination at the Coventry Bankruptcy Court on Monday. He stated that he commenced business in May, 1920, at George Street, Nuneaton, with a capital of £70. He executed a deed of arrangement on April 23rd, 1923, as the result of a meeting of his creditors, but one of the principal creditors, who was not present at the meeting, took proceedings against him and levied an execution, in consequence of which debtor filed his petition. He had only kept a sales day-book. The causes of his failure were that one firm who owed him £168 went into liquidation, and he only got 7s. in the £, while another firm failed to pay him, and his creditors started "rushing" him; he was also affected by bad trade owing to the coal strike. He knew he was insolvent 12 months ago, but thought, given a fair trial, he could pull round. The examination was closed.

P. Rothwell (in partnership with P. A. Rothwell (a minor) as P. A. Rothwell & Co.), electrical engineers, 64, Higher Bridge Street, Bolton.—Last day for proofs for dividend, June 27th. Trustee, Mr. J. G. Gibson, Official Receiver, Byrom Street, Manchester.

Dissolution of Partnership.—Sefton Electrical Co., electrical and sanitary engineers, 310, Smithdown Road, Liverpool.—Mr. H. Davies and Mr. E. Murray have dissolved partnership. Mr. Davies will attend to debts and continue the business.

Company Liquidations.—The Russell Electrical Appliances Co., Ltd., manufacturing electrical engineers, Belfast Road, London, N.—A meeting of the creditors of the above was held recently at Bank Chambers, 76, Kingsland High Street, E., when Mr. Alfred Neill, the liquidator in the voluntary liquidation of the company, submitted a statement of affairs which showed liabilities of £340. Of that amount £308 was due to the trade, £14 to cash creditors, and £19 to the bank. The assets were estimated to realise £686, from which had to be deducted £132 for preferential claims, leaving net assets of £555, and a surplus was thus disclosed so far as the creditors were concerned. The assets consisted of: plant and machinery, £177; fixtures and fittings, £13; cash in hand, £5; office furniture and fittings, £16; and stock-in-trade, £474. It was reported that the company was formed in April, 1922, with a nominal capital of £2,000, of which £1,225 had been issued and was fully paid. It was pointed out that if the stock on the premises was completed it might

realise more than the amount at which it was set down. The liquidator added that he was endeavouring to dispose of the business as a going concern. A resolution was passed confirming the voluntary liquidation of the company, with Mr. Neill as liquidator. The following are creditors:—

	£		£
Berisford, J., & Son	26	Potter, G. W., & Co.	14
Mould, A. H., & Sons, Ltd. ...	98	Green, Martin	13
Page, G. W.	17	Wright & Sons	11
Jordan & Son	15		

BELL BATTERY CO., LTD.—A meeting of members is called for July 11th at 1, Great Winchester Street, E.C., to hear an account of the winding up from the liquidator, Mr. F. Wilcock.

INSTITUTION OF ELECTRICAL ENGINEERS (incorporated under the Companies Acts, 1862-1867).—A meeting of corporate members and associates of the Institution will be held at the Institution, Savoy Place, W.C.1, on July 19th, to receive the report and accounts of the liquidators, showing how the property has been disposed of, &c. (All creditors have been paid in full and the property of the old Institution has been transferred to the Institution of Electrical Engineers, incorporated by Royal Charter dated August 15th, 1921.)

Private Arrangements.—DONALD ALEXANDER MUNRO and JOHN JAMES MOIR, trading as Munro, Moir & Co., 8, Endell Street, London, W.C., electrical dealers, &c.—The creditors interested herein were called together recently at the Institute of Chartered Accountants, Moorgate Place, E.C., when the chair was occupied by Mr. E. H. Hawkins, of Messrs. Poppleton, Appleby & Hawkins. A statement of affairs was presented by Mr. C. R. Dormer, of Messrs. Cooper Bros. & Co., C.A., George Street, Mansion House, London, E.C., which disclosed liabilities of £9,641, of which £1,757 was due to the trade and £7,884 to cash creditors. There were also fully secured creditors for £342, who held security valued at £500. The assets totalled £1,154, from which had to be deducted £198 for preferential claims, leaving net assets of £956, or a deficiency of £8,684. The assets consisted of: stock-in-trade £1,500, expected to produce £500; furniture, fixtures and fittings, £67; machinery, plant and tools, £95; good book debts, £332; return of part premium employers' liability, £2 10s.; and surplus from security in the hands of fully secured creditors, £158. The fully secured creditors were the bank who held the lease of 8, Endell Street as security for their claim. The principal cash creditor was a relative of one of the debtors, in respect of £5,000 advanced when the business was commenced, and he had since made further advances. The business was started in 1914, and since that date profits had only been made in two years. Since 1919 the losses had been increasing. The average yearly sales had been £5,800, with gross profits of about £1,400 per annum. The drawings had been very small. It was stated that the principal cash creditor was prepared to assist the debtors, and he had handed over £650 in cash which would ensure the trade creditors receiving a minimum dividend of 5s. in the £. It was proposed that a deed of assignment should be executed to Mr. Dormer, and that the estate should be realised. A resolution was passed expressing approval of the proposal. The following are creditors:—

	£		£
Albany Manufacturing Co. ...	20	Jones & Pordes, Ltd.	23
Bailey, John	25	Littauer, James	16
Burn, George, Ltd.	29	Langley, Shaw & Co.	30
Braby, Fredk., & Co., Ltd. ...	11	Mair, Morris & Co., Ltd. ...	32
Cooke & Segal, Ltd.	243	Midland Wire Cordage Co. ...	12
Cooper Bros. & Co.	53	Macintosh Cable Co., Ltd. ...	18
Dobbs Bros., Ltd.	19	Marston, Albert, & Co., Ltd. ...	12
Edison Swan Electric Co., Ltd.	14	Price, T., & Sons (Stampers), Ltd.	26
Evered & Co., Ltd.	11	Planet Stamping Co.	17
Ellis, Matthew, Ltd.	32	Scottish Tube Co., Ltd.	35
Fletcher, Abel & Sons	20	Steer, Joseph	48
Guest, Keen & Nettlefolds ...	13	Snashall & Son	15
Gibbons, Wilson & Co., Ltd. ...	31	Standard Gas Fittings Co., Ltd.	17
Grothe & Sohne	11	Siemens Bros. & Co., Ltd. ...	42
General Electric Co., Ltd. ...	11	Shaw, E. A.	75
Benn Bros., Ltd.	20	Twigg, Charles, & Co.	76
Herbert Kershaw & Co., Ltd. ...	57	Tomey, Joseph, & Sons, Ltd. ...	15
Hackett, T., & Sons	15	United Hinges, Ltd.	12
Harrison, G., & Sons	31	Wilkins & Wright	12
Hackleton, J., Ltd.	12	Whitehead, R. R., & Bros., Ltd.	15
Initial Carrier Co.	15	Wheeler, W., and Sons	11
Johnson & Jorgensen	23	Whitehouse, Wm., & Co., Ltd.	28
Ironmonger	38		

SAM GEORGE WILKINSON, 25, Havelock Road, Harrow, late 76, High Road, Wembley, electrician.—The receiving order in this matter was made on May 7th on a creditor's petition. The statement of affairs shows liabilities of £4,194, while the assets are estimated to realise £317, from which preferential claims of £24 have to be deducted, leaving net assets of £291, or a deficiency of £3,902. Debtor attributes his failure to bad trade. It appears that after having sold a business of his, he paid his liabilities, and with a balance of £400 commenced business in partnership with another as an electrical engineer at 76, High Road, Wembley. They traded as the Wilton Electrical Co., and his partner, who was a practical electrician, was to receive one-half of the profits and £3 a week as wages. No profits were, however, paid to his partner, who retired from the concern in December, 1922. There are some debts still outstanding which were incurred during the partnership. On March 23rd last debtor executed a deed of assignment to a trustee, who has been requested to render an account of his receipts and payments.

Trade Announcements.—MR. WATSON, of Messrs. W. G. Watson & Co., Ltd., electrical engineers and merchants, Sydney, Australia, who is now in this country, informs us that as from July 1st, Messrs. SANDERSON, MURRAY & ELDER, LTD., of 2, Gresham Buildings, Basinghall Street, E.C.2, will represent them as buyers and shippers under the personal supervision of Mr. J. Maitland Jones, of Messrs. Turnbull & Jones, Ltd., electrical engineers, of New Zealand, and Mr. Holliday.

Messrs. WHEELER & PEARCE have moved from Cambridge Street to 218, Rockingham Street, Sheffield.

Mr. J. A. HOOD, sole partner in the firm of Clarkson, Hood and Co., 45, Hope Street, Glasgow (representatives for the Ateliers de Constructions Electriques de Charleroi) has taken Mr. A. W. KILPATRICK into partnership. The firm's name will be unaltered and the firm will continue to act as Scottish representatives for Messrs. Watshams, Messrs. E. G. Lind & Co., and Messrs. Townshends, Ltd.

Mr. WILLIAM BROWN has commenced business as an electrician in Barnes Street, Strathaven, with Mr. H. MASON as partner, under the style of Brown & Mason.

Mr. E. A. WOOD, of Aston Road, Birmingham, has opened showroom and sales premises for wireless sets, electrical fittings, and supplies at 105/7, John Bright Street, Birmingham, also a Scottish branch at 77, Gallowgate, Glasgow.

Catalogues and Lists.—THE ENGLISH ELECTRIC CO., LTD., Queen's House, Kingsway, W.C.2.—Publication No. 456, describing a new line of induction motors for medium and large outputs produced by this company. The information is detailed and well illustrated.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—Booklet B.C. 2,964, containing illustrations and prices of radio accessories. Catalogue Section V (3) and Folder V 1313 giving reduced prices of "Freezor" fans. Also Folder No. W 2,927, giving particulars of "invisible" bell wire.

THE LONDON ELECTRIC FIRM, Brighton Road, Croydon.—A series of illustrated pamphlets, mainly reprints from the technical Press, describing the firm's searchlights, cable drums, flexible couplings, and other products.

THE ELECTRIC HEATING CO., Croydon.—Illustrated and priced pamphlets dealing with "Elect" irons, kettles, fires, &c.

MESSRS. SHENTON & CO., LTD., 68 and 69, Shoe Lane, E.C.4.—Price List (No. C 23) of electrical accessories, including cables, adaptors, insulators, ironclad switchgear, lighting fittings, &c.

THE STERLING TELEPHONE & ELECTRIC CO., LTD., 210-212, Tottenham Court Road, W.1.—Publications Nos. 350 and 357, dealing respectively with the Sterling combined crystal and valve receiving set, and a multiple connector for telephones. Illustrated and priced.

Mr. M. W. WOODS, 15-16, Railway Approach, London Bridge, S.E.1.—An illustrated pamphlet describing small battery-charging sets—a.c. to d.c. and d.c. to a.c.

ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI, 56, Victoria Street, S.W.1.—June stock list of motors and dynamos.

MESSRS. H. E. ASHDOWN (BIRMINGHAM), LTD., Perry Bar, Birmingham.—A priced and illustrated booklet dealing with valve radio receiving sets and accessories.

PIGGOTT CABLES & CONDUIT CO., 24, New Bridge Street, E.C.4.—A folder, designed on novel lines, giving trade prices of 600-megohm grade v.i.r. non-Association cables.

MR. FREDERICK PRATT, 23, Queen Anne's Gate, S.W.1.—Three illustrated pamphlets dealing with "Vanwyk" small overload switches, "Z" fuses, "Elkay" electricity meters, &c.

MESSRS. FLEMING, BIRKBY & GOODALL, LTD., Liversedge, Yorks.—A mailing card advertising "Elo" insulating material.

FOSTER ENGINEERING CO., LTD., Morden Works, Wimbledon, S.W.19.—A fully-illustrated and priced catalogue of ironclad switch- and fuse-gear, including explosion-proof and quick-make and break types.

MESSRS. C. A. BESLEY, BAILEY & CO., LTD., Hope Street Lane Works, Cardiff.—A postcard illustrating a new motor terminal box.

The Boilermakers' Lock-out.—At a conference of delegates from the branches of the Boilermakers' Society, held on June 6th, it was decided to intimate to the Shipbuilding Employers' Federation that the members of the Society would return to work if time rates, instead of piece rates, were conceded. This proposal has been made before, but the employers viewed it with disfavour. The executive of the Society asked for another meeting with the employers' representatives.

In response to this request the employers intimated their willingness to meet the Society's representatives again, but, referring to the piece work wage basis, stated that it was not possible to grant differential treatment to the members of one union. They further contended that there was no case for arbitration, as the alterations were made under a fully ratified agreement between the Shipbuilding Employers' Federation and the Federation of Engineering and Shipbuilding Trades, from which the Boilermakers' Society has seceded.

"Not Guilty."—Before the Common Serjeant, at the Central Criminal Court on Tuesday, JOHN WYATT, 43, electrician, on bail, was found "Not guilty," on a charge of forging an account book relating to a fund of the Electrical Trades Union, and he was discharged.—*The Times.*

E

United States Electrical Exports.—Preliminary figures give the value of the exports of electrical goods from the United States during the month of March, 1923, as $6,344,842, which shows a considerable increase over both the preceding month and the same month of last year. It is also nearly as great as the total for January, 1923. For the first three months of 1923 the total electrical exports have been $17,585,523, as compared with $14,199,436 for the first quarter of 1922.

Practically all classes of electrical goods maintained their position in March, very few showing decreases over the preceding month. Gains have been small in apparatus lines, but have been more marked in supply and appliance items. Electric-locomotive exports were $474,098 in March, as compared with $874,379 for January, and none in February. Fans, radio materials, wiring supplies, and insulated copper wire and cable all show steady gains. The increase in fans and various domestic electric appliances marks the seasonal buying from the Southern Hemisphere.—*Commerce Reports.*

The F.B.I. Royal Charter.—The Federation of British Industries has been granted a Royal Charter of Incorporation by the King. This is regarded as a recognition of the important place that the F.B.I. has won for itself in the life of the country.

Local Exhibitions.—The Electrical Development Association draws our attention to the forthcoming exhibitions at Stoke-on-Trent (September), Newport (October), and Lincoln (October). That at Newport will be on a rather larger scale than usual, the general conditions being in accordance with E.D.A. recommendations, and the tariffs and other facilities in the district justifying ample support by manufacturers.

Electric Home-cleaning.—A company which combines the two virtues of the use of electricity and the employment of ex-Service men is offering its service in this season of spring cleaning. This is the Electric Home Cleaning Service Co., Ltd., 57, Mortimer Street, W.1, which employs carefully selected and trained men and electric vacuum cleaners, and at a low charge lightens the labour of keeping the home clean.

German Imports into Australia.—An Exchange Telegraph dispatch from Melbourne states that German imports into Australia during March amounted to £60,000, including motor chassis, £12,000; musical instruments, £10,000; machinery, £6,000; metals, jewellery, scientific instruments and chemicals, £4,000 each.

Book Notices.—*Wireless Weekly.* Vol. I, Nos. 1-5. London: Radio Press, Ltd. Price 6d. net each.—This new periodical is edited by Mr. J. Scott-Taggart, F.Inst.P., and he is assisted by a number of other well-known experts in the subject. The articles cover both the theory and practice of the art of radio-telephony and telegraphy, and are written in a clear and not-too-difficult style. They range over a wide field and are very practical.

"Electric Lift Equipment for Modern Buildings," by R. Grierson; pp. xii+179; 96 figs. London: Chapman & Hall, Ltd. Price 15s. net.

"Central Electric Stations in Canada. Part II—Directory" (Water Resources Paper No. 33); 482 pp.; 16 plates. Ottawa: Department of the Interior. This directory contains very full particulars of 826 stations, of which 513 generate their own power, the remainder dealing with bulk supplies. The details given include: generating plant, system of supply, number of consumers, rates of charge, &c.

"A Fair Wage," by E. Batten. Pp. ix+90. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

An excellent souvenir of their visit to the company's works during the recent Summer Meeting of the I.E.E. was presented to members of the Institution by the Metropolitan-Vickers Electrical Co., Ltd. This took the form of a brochure describing the firm's works and products, copiously illustrated by means of reproduced photographs and black-and-white drawings—altogether an artistic production in keeping with the position occupied by the firm in British electrical engineering.

During the same meeting, the Chloride Electrical Storage Co., Ltd., also issued a well-produced booklet upon its manufactures, showing the making of parts of accumulators, assembling and packing, &c. The subject is treated in an interesting narrational manner and fully illustrated.

Trade Situation in Uruguay.—In his report dated January, 1923, Mr. E. A. Cleugh, H.M. Vice-Consul at Montevideo (H.M. Stationery Office, 1s. net), in reviewing the present position, says that the two problems which Uruguay has to face to-day are the state of the national finances and the industrial depression which is so seriously affecting the Republic. The continuance of the depression of trade which has been more or less universal since 1920 inevitably involves Uruguay. "It is true that the wool season opened favourably and the market remained firm and even improved, but it was an alleviation and not a remedy of the situation, since the prosperity of this pastoral country depends upon its meat industry. Uruguay depends very largely upon the European market for the disposal of her meat, and the difficulty experienced in placing this staple product of the country has been the chief obstacle to a return to better conditions. Adverse exchanges, falling off of revenue and consequent additional taxation, are conditions which make immediate recovery impossible. Nevertheless, Uruguay is economically sound in all essentials, and there is no doubt that she will react rapidly to any amelioration in economic conditions in Europe. The financial difficulties with which the country is at present struggling will then be automatically reduced." In referring to building activity, which is on the increase, Mr. Cleugh remarks that houses are being built now in a much more modern style, the old Spanish one-storey house with a central courtyard being abandoned in favour of houses of more than one storey, with ample lighting, ventilation, and sanitary arrangements. With regard to imports in general the increase in the amount is due to the slightly improved and stabilised exchange situation and the exhaustion of accumulated stocks. British trade, so far as can be judged, shows an improvement over 1921, but is still below 1920. "Uruguayan importers have always shown themselves anxious for trade with the United Kingdom, but they became discouraged by adverse exchange and frequent inability of British manufacturers to meet their demands. Latterly, however, their interest has been reawakened, and so long as manufacturers and exporters at home maintain their standards of production and show their desire to consider the particular needs of this market, it is hoped that this interest will be maintained. Strongly competitive prices will be met, however, in view of the strong bid being made by Germany and the U.S.A. for this market, and Uruguayan importers are scrutinising comparative prices more severely and with less bias than before." It also appears that in many cases French and Belgian firms are cutting their prices very fine and are making a strong combination for increasing their hold upon the market, *particularly in electrical goods.*

"Germany has steadily increased her exports to this country during the last three years. . . . The sale of German goods has been indefatigably promoted in this market and every means of price and novelty employed to attract the Uruguayan importer. Germany's chief interest in this market consists still of chemicals, drugs and dyes and electrical goods, but no possible branch of trade is neglected and full advantage has been taken of the exchange situation."

In general the market may be considered a favourable field for British enterprise, but severe competition will be met with and competitive prices must be quoted. The tastes of the market are worth studying and it should not be treated merely as an offshoot of Argentina. "Admittedly the appreciation of the £ sterling renders competition difficult, and it may not be thought that the present is the time for expending money on propaganda and advertisement. On the other hand, there are indications that the situation here may improve and foreign competition will not be slow in seizing every opportunity, even at the cost of a temporary sacrifice."

Colonial Apprentices for British Works.—The Newcastle Chamber of Commerce has approved a suggestion that Colonial apprentices should be attracted to this country, so that when they returned they could talk of British manufactures.—*Financial Times.*

British Trade-Mark Applications.—The following are included among the recent applications for British trade marks. Objections may be lodged within one month from the dates mentioned. In the case of foreign applications the names and addresses of the British representatives are also given:—

Air-Way. No 425,217. Class 6. Electric motors, electric cleaning machines, &c. Air-Way Electric Appliance Co., 618-622, Broadway, Toledo, Ohio, U.S.A. (Marks & Clerk), 57-58, Lincoln's Inn Fields, London, W.C.). June 6th, 1923.

Electroflo. No. 434,026. Class 8. Instruments for the electrical measurement of the flow and pressure of liquids. Burton Dunglinson, Ruskin Chambers, Scale Lane, Hull. June 6th, 1923.

Magnet. No. 421,385. Accumulators, batteries, dry cells, cables, induction coils, resistances, fitted switchboards, meters, telephonic instruments, &c., in Class 8. No. 421,386. Accumulators, batteries, induction coils, magneto machines, &c., in Class II. No. 421,387. Electrical goods of ordinary metal in Class 13. The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C. June 6th, 1923.

Melohay. No. 434,116. Class 8. Apparatus for wireless telegraphy and telephony. Walter H. Hayes, 344, Euston Road, London, N.W. June 6th, 1923.

Rely-on-the-Relay (lettering and design). No. 434,352. Philosophic and scientific instruments in Class 8. The Relay Automatic Telephone Co., Ltd., Marconi House, Strand, London, W.C. June 6th, 1923.

Fortevox (lettering and design). No. 436,079. Class 8. Apparatus for use in connection with wireless telegraphy and telephony. W. Petrie Fraser, trading as Fraser & Glass, Assembly Works, Middle Lane, Hornsey, London, N.8. June 6th, 1923.

LK. (lettering and design). No. 433,870. Electrical goods in Class 8. Elkay Electrical Manufacturing Co., Ltd., 4, Southampton Row, London, W.C. June 6th, 1923.

Resiston. No. 436,041. Class 50. Electrical insulating substances of asbestos, mica, resin, oils or bitumen. The American Hard Rubber Co., 11, Mercer Street, New York, U.S.A. (Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.). June 6th, 1923.

Constantinople Telephones.—According to a statement issued by the Turkish Press Bureau, based on official information from Angora, negotiations with various companies supported by foreign capital are progressing, and an agreement has been reached regarding six concessions with British capital, while negotiations with the Constantinople Telephone Co. are proceeding favourably.—*Reuter* (Lausanne, June 7th).

South African Electrical Trade.—The *South African Mining and Engineering Journal* for May 19th stated that the electrical business, owing to the increased building activity, was fairly good, and prospects of improvement were better than they had been for some time.

For Sale.—Kirkcaldy Corporation Electricity and Tramways department has for disposal two 250-h.p. Browett-Lindley compound engines direct coupled to Laurence-Scott 150-kW generators. (See our advertisement pages to-day.)

Edinburgh Electricity Department has for disposal 15 tons of clean scrap high-conductivity copper wire.

Edinburgh Battery Contracts.—Messrs. Pritchett & Gold and E.P.S. Co., Ltd., have secured a contract for the supply of a new battery for the Dewar Place power station of the Edinburgh Corporation. The firm has recently completed the erection of two batteries at the Edinburgh Corporation's Portobello station.

G.E.C. Sports.—The fourth annual sports meeting of the London establishments of the General Electric Co., Ltd., is to be held at the London County Athletic Ground, Herne Hill, S.E., on June 23rd.

The Metric System in Russia.—The *Ost Express* learns that the metric system, which the Russian post and telegraph authorities were to have introduced on June 1st, will also be adopted during 1923/24 by the big industrial works and later by the wholesale and retail trade. It is hoped that this system will be general in Russia by 1927.—*Reuter's Trade Service.*

LIGHTING AND POWER NOTES.

Asia Minor.—HYDRO-ELECTRIC DEVELOPMENT.—A group of German capitalists has applied for a concession to erect hydro-electric power stations in Anatolia to provide electrical energy for factories. Permission has been granted by the Turkish Government to the group to make preliminary researches.

Australia.—VICTORIA.—It is reported from Melbourne that a high-pressure line has been erected between Geelong and Colac, a distance of 50 miles, at the rate of a mile in two days, being finished three weeks before the scheduled time.

NEW SOUTH WALES.—The New South Wales Railway Commissioners have selected a site at Middle River, Marrangaroo, for the erection of a power station to supply electrical energy to the railway and towns on the western line. The station will eventually be connected up with Sydney. It is anticipated that money will be available to proceed with the scheme at the commencement of the next financial year.

Barrow.—LOAN.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £4,520 in connection with the supply of electricity to the Anti-Cross Mine of the Barrow Hematite Steel Co., Ltd.

Billingham.—SPECIAL ORDER.—The Urban Council has decided to offer no objection to the application by the Cleveland and South Durham Electric Power Co. for a special Order authorising the company to supply electricity in the district. The proposed charge for electricity is 7d. per kWh.

Birkenhead.—LOAN.—The Town Council has applied to the Electricity Commissioners for sanction to a loan of £1,700 for the purpose of giving a supply of electricity to the gas works. The Council has received an inquiry from Moreton Parish Council as to terms for the supply of electricity to the district. The electrical engineer is to interview representatives of the Parish Council and report.

Birmingham.—YEAR'S WORKING.—The accounts of the municipal electricity undertaking (engineer: Mr. R. A. Chattock) for the year ended March 31st last, record a total income from all sources of £1,044,123, which was almost the same as that of the previous year—£1,041,844. The working expenses were £569,542, as compared with £725,042 in the previous year, leaving a gross profit of £474,581 as against £316,802. Capital charges were higher—£373,935, as against £312,291—but the net result was a profit of £107,160, a large increase upon the profit for the previous year (£40,858). The surplus was allocated as follows:—To borough rate, £12,500; to renewals and special expenditure, £70,000; and to reserve fund, £24,660. The balances of the last two funds are now £102,234 and £127,759. The capital expenditure during the year amounted to £394,859, bringing the total up to the end of the year to £4,165,685. The principal items were: machinery and plant, £221,026; and mains, £106,598. The sales of energy totalled 139,468,153 kWh, as against 111,038,406 kWh in 1921-22.

Buxton.—ELECTRICITY CHARGES.—The Town Council has applied to the Electricity Commissioners for authority to maintain the maximum charge of 9½d. per kWh for electricity until March 31st next, and to fix the maximum charge as from that date at 9d. per kWh.

Continental.—GREECE.—The Greek Government has proclaimed a competition for a concession for the exploitation of the hydro-electric resources of the River Voda, near Uladova, in Macedonia. The firm securing the concession will have a monopoly of the electricity supply to the town of Salonica and also to certain other districts in the vicinity.

SARDINIA.—It is proposed to proceed with a storage hydro-electric scheme on the Tirso River. The flow for about eight months of the year is practically *nil*, but sufficient water can be collected during the remaining four months to provide a continuous supply of electricity. The scheme includes the construction of a reservoir to hold 602,000,000 cubic yards, and an annual output of 50 million kWh is anticipated. A somewhat larger project is that planned for the utilisation of the Coghinos river to produce 80 million kWh annually; this would also involve the construction of a huge reservoir. It is stated that the power from these two schemes, supplementing that from existing stations, would be ample to meet the requirements of the island for a considerable time.

LATVIA.—A scheme is in hand for the erection of a power station near Dahlen, and the Government and the municipality of Riga have agreed to undertake the work jointly. The necessary funds are to be raised by loans, concerning which negotiations are already proceeding with the Ministry of Finance. The construction of a canal and the power station is estimated to cost about one milliard Latvian roubles, and the work will be finished in about three years. It was first planned to interest foreign capital in the enterprise by means of concessions, but the Ministry of Finance is of opinion that the erection should be undertaken with the country's own means. Several foreign firms have submitted offers for the supply of machinery for the station.—*Reuter's Trade Service* (Riga).

RUSSIA.—The Glavelektro (Chief Electrical Authority) is investigating the central district of the Don Basin to find the most suitable site for a power station to serve the coal industries, factories, and mines of the Petrovsk combination, and also to supply electrical energy to the town of Bachmut. The station will also have to serve as a reserve source of supply to the salt district of the Don. Along with this, it is intended to provide new electric mains amongst the mines over a total distance of 40 km., and a second line of about 30 km. for the distribution of current in the salt district.

The construction of the electricity works at the peat field near Ekaterinburg, according to the plan for the electrification of the Ural, has begun. The chief electrical industries authority is assisting to the extent of an investment of 400,000 gold roubles. A share company has been formed with a capital of 2,000,000 gold roubles. The capacity of the station is calculated at 13,000 kW, and the construction will be finished in 1925.

Devizes.—OPPOSITION WITHDRAWN.—The Rural Council has decided to consent to the application of the Western Electric Distributing Corporation, Ltd., for a Special Order to supply electricity within the Council's area.

East Midlands Electricity District.—LOCAL INQUIRY.—With respect to the Electricity Commissioners' provisional delimitation of the above-named area in October, 1920, and the scheme submitted by a conference of municipal electrical undertakers in the district providing for the establishment of an Advisory Committee, in connection with which the Electricity Commissioners held a local inquiry at Nottingham in January, 1923, the Commissioners give notice that they intend to hold a second local inquiry at the Guildhall, Nottingham, on Tuesday, July 10th, 1923, at 10.30 a.m., in order finally to determine the area of the proposed district.

Huddersfield.—INQUIRY.—The Electricity Commissioners' inquiry into the conflicting applications of the Corporation and the Electrical Distribution of Yorkshire, Ltd., for powers to supply certain districts near Huddersfield (*vide* ELEC. REV., June 1st, p. 855), was continued by Col. T. C. Ekin on June 8th. Mr. Beveridge, for the company, testified as to the ability of his clients to carry out a scheme successfully by giving details of what had already been done by the company. The company considered that the rate of charge proposed by the Corporation was too low and the ratepayers would have to sustain the resultant loss. The company could provide a supply much more quickly and economically than the Corporation. Mr. W. B. Woodhouse said that in the course of the next three years the Huddersfield station would be regarded as inefficient. The Corporation's profit was much higher than that of the company. In his opinion a national supply would never be obtained by extending the municipal undertakings; the company was endeavouring to make the supply in Yorkshire one big scheme. On May 9th, Mr. R. Harker gave evidence to the same effect, but Mr. Miller, K.C., who appeared for the Corporation, pointed out that Huddersfield and other municipalities in Yorkshire had developed to a large extent some years before the company had obtained its powers. The Corporation's case was that it could supply energy at a lower rate than the company. The inquiry was then closed.

Irish Free State.—YOUGHAL (CO. CORK).—In connection with the proposal to introduce electric lighting, at a recent meeting of the Urban Council it was stated that the estimated cost of plant was £6,500. The proposal was referred back for consideration at the next meeting.

Leigh (Lancs.).—YEAR'S WORKING.—According to the report of the borough electrical engineer (Mr. J. B. Hudson) for the year ended March 31st last, the gross income of the undertaking amounted to £35,692, comparing with £30,691 in the previous year. The working expenditure totalled £18,836, as against £21,930, leaving a gross profit of £16,856 (£8,761). The final result was a net profit of £5,990, comparing favourably with a loss of £273 in 1921-22. Meters costing £478 were provided out of revenue, and the net profit was sufficient to liquidate the accumulated deficits from previous years on the net revenue and depreciation and renewals accounts, while a balance of £683 was transferred to the latter account. The energy sold increased from 2,252,655 kWh to 3,269,396 kWh.

London.—CITY OF LONDON.—The City of London Retail Traders' Association and other retailers carrying on business within the confines of the City, are petitioning the City Corporation to secure a reduction in the existing charges for electricity. The present maximum charge in the City is, the petition states, eightpence per kWh, as compared with about half that price before the war, and compares unfavourably with rates in other parts of London and in the country.—*The Times.*

HACKNEY.—The Electricity Committee has fixed October 25th as the date for the formal inauguration of the 10,000-kW extension of the electricity works.

Maidenhead.—LOAN.—The Town Council has applied to the Electricity Commissioners for sanction to loans of £8,000 for mains and £700 for services.

Mold.—ELECTRICITY SUPPLY.—The Urban District Council has requested the North Wales Power Co., Ltd., to submit a scheme for the supply of electricity to the district.

New Zealand.—POWER FROM MANGAHAO.—The Hutt Valley Electric Power Board has in hand a scheme for supplying electricity in the Hutt Valley district. Power to an ultimate capacity of 2,000 kVA is to be supplied from the hydro-electric station at Mangahao. The estimated cost of the scheme is £200,000.

North-East Worcestershire.—SPECIAL ORDER.—The Electricity Commissioners have made a Special Order authorising the Shropshire, Worcestershire and Staffordshire Electric Power Co. to supply electricity in the borough of Droitwich, the urban districts of Bromsgrove and North Bromsgrove, and the rural districts of Bromsgrove and Droitwich.

Nottingham.—YEAR'S WORKING.—The report on the working of the electricity undertaking for the year ended March 31st last shows a total revenue of £269,566. Working expenses totalled £152,109, leaving a gross profit of £117,457. After payment of interest, sinking fund charges, &c., there was a net profit of £61,936, out of which £11,500 has been placed to the relief of the rates and £50,000 to the reserve fund. The number of kWh sold was 20,401,526, an increase of 2,991,234 on the previous year.

Price Reductions.—Reductions in the charges for electricity have been made in the following districts:—

CREWE.—Electricity for all purposes from 75 per cent. to 60 per cent. above the pre-war rate.

TONBRIDGE.—Lighting: From 8d. to 6d. per kWh. Power: A reduction of 2d. per kWh in the sliding scale and 1d. per kWh in the maximum demand rate.

WORTHING.—Lighting: From 8d. to 7d. per kWh.

CAMBRIDGE.—*Cambridge Electric Supply Co., Ltd.*—Lighting: From 8d. to 7d. per kWh. Power and heating: 4d. per kWh for the first 100 kWh per quarter and 1½d. per kWh beyond. The additional charge of 10 per cent. is to be withdrawn.

South Devon.—SPECIAL ORDER.—Application has been made to the Electricity Commissioners by Mr. R. Hartree, of Salcombe, for a Special Order authorising him to supply electricity in certain parts of the rural districts of Kingsbridge, Totnes, and Newton Abbot, and the urban districts of Ashburton and Buckfastleigh.

Taunton.—YEAR'S WORKING.—The Electricity Committee reports that after the payment of working expenses, capital charges, cost of renewals, &c., there remains a net profit of £4,003 for the year ended March 31st last. This, with £722 brought forward, makes an available total of £4,725. Of this amount £1,368 is contributed to the District Rate and the balance transferred to reserve.

Thames Valley.—SPECIAL ORDER.—The Thames Valley Electric Supply Co., Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity in the borough of Henley-upon-Thames and certain parishes in the rural districts of Henley and Wokingham.

Torquay.—LOAN.—The Town Council has applied to the Electricity Commissioners for sanction to a loan of £90,143 for mains, power station buildings, &c. The engineer has been authorised to purchase electric cookers at a cost of £200 for letting out on hire.

Ulverston.—ELECTRICITY IN BULK.—In connection with the proposal to obtain a bulk supply of electricity from the Barrow Corporation, a canvass of the residents has proved satisfactory, and the Urban District Council has decided to accept the Corporation's terms for a supply.

West of Scotland Electricity District.—TIME EXTENSION.—The date by which objections and representations with respect to the proposed reorganisation of the supply of electricity in the above-named provisionally delimited area must reach the Electricity Commission has been postponed a second time—namely, from June 30th until December 31st, 1923.

Wimbledon.—EXTENSION OF MAINS.—The Electricity Committee has recommended that the mains be extended in various districts at a cost of £8,615.

TRAMWAY AND RAILWAY NOTES.

Aberdare.—PENNY FARES.—The District Council has decided to introduce penny fares on its tramway system as an experiment for a period of three months. It was pointed out at a recent meeting that there was a loss of £13,000 in spite of the fact that £9,000 had been carried forward from revenue.

Accrington.—RAILLESS CARS.—The Town Council has under consideration a proposal to run railless cars.

Burnley.—YEAR'S WORKING.—We have received the balance sheet and the report of the general manager of the tramways (Mr. H. Mozley) for the year ended March 31st last. The revenue is given as £170,900, and the working expenditure as £133,400. The equivalent figures for the previous year were £163,058 and £144,632. The gross profit of £37,500 thus compared with £18,426 in 1921-22. This was entirely absorbed by interest and sinking fund, rent for leased tramways, income tax, and a sum of £16,474 transferred to the reserve, renewals and depreciation fund, and revenue balances due to the Borough Fund, year 1921-22, leaving a balance owing to the former fund of £36,000 and to the latter fund £30,737.

Only about 60 per cent. of the permanent way has been relaid, and it becomes necessary to provide £49,424 for this purpose during the current year, but the rate of depreciation can be lowered. The capital expenditure remained at £253,354, as nothing was spent on this account during the year.

The number of passengers carried increased from 19,164,508 to 21,349,624, and the number of car-miles run from 1,522,278 to 1,744,272.

Continental.—SWEDEN.—The Minister of Communications has submitted to the Riksdag the result of the inquiry demanded by the Riksdag as a condition of the appropriation of kr. 23,000,000 for commencing the electrification of the railway between Stockholm and Gothenburg. The Riksdag has accepted the report of the Budget Committee, and declares that it has no objection to the starting of the electrification if the Government thinks fit. The Minister emphasised the fact that the total cost of the work, originally estimated at kr. 105,000,000, had now been brought down to kr. 39,000,000, and stated that he considered the present moment highly suitable for commencing the work.—*Reuter's Trade Service* (Stockholm).

Lytham-St. Annes.—NEW CARS.—The Town Council has decided to purchase ten new covered-top tramcars at a cost of £1,538 each.

LOAN.—Application is being made to the Ministry of Transport for sanction to the borrowing of £2,000 for extensions to the tramsheds at Squire's Gate.

Manchester.—AGREEMENT WITH STOCKPORT.—The lease for running the Corporation's tramcars into Stockport has expired, and the two authorities have agreed that mutual running shall be exercised as soon as the Stockport Town Council has completed its arrangements for new cars and car-shed accommodation. In the meantime the profits of the Manchester Corporation's cars on the Stockport route will be shared.

Nottingham.—YEAR'S WORKING.—The report on the working of the tramway undertaking for the year ended March 31st last shows a total revenue of £400,109, an increase of £44,229 on that of the previous year. Working expenses amounted to £317,041 (£314,008), leaving a gross surplus of £89,067 (£47,871), which has been disposed of as follows:—Interest, stocks and loans, £18,630; capital charges, £26,070; reserve and renewals, £34,366; relief of the rates, £10,000. The number of passengers carried was 61,791,199, an increase of 6,408,644 on the previous year.

South Africa.—RAILWAY ELECTRIFICATION.—The general manager of the South African Railways reports that steady progress is being made with the scheme of electrification on the Natal main line between Glencoe and Maritzburg. Excavations and concreting for the foundations of the large power station at Colenso are proceeding.

West Houghton.—LOAN SANCTIONED.—The Urban District Council has received the sanction of the Ministry of Transport to the borrowing of £4,539 for widening Bolton Road in connection with the scheme for laying a tramway track in the district.

TELEGRAPH & TELEPHONE NOTES.

Algeria.—Telephone Service.—In view of the activity of French manufacturers of telephone apparatus in supplying home requirements, there may be an opportunity for British suppliers to participate in the reconstruction of the Algerian telephone system in spite of the preference usually given in that French dependency to national material. The local Merchants' Association has petitioned the authorities in Paris for the modernisation and extension of the whole system. Delays on trunk lines are in particular a constant cause of complaint. It is proposed completely to revise the present system of charges for installation and service. The opinion has been expressed that the construction of an entirely new system would be less costly than the repair of the existing system.

Denmark.—Telegraph Earnings.—The Danish Telegraph Department's operating income for the October quarter of 1922 was 3,018,602 crowns, as against 3,726,191 crowns during the same quarter of 1921; disbursements for the same periods were 3,138,040 crowns and 3,609,424 crowns respectively, showing a deficit for the 1922 quarter of 119,438 crowns, as against a surplus of 116,767 crowns in the corresponding quarter of 1921. For the period, April-December, 1922, however, the income totalled 9,412,170 crowns, as against 10,894,080 crowns in the 1921 period. The expenses during these periods were 9,246,585 crowns and 11,111,365 crowns respectively. For the full three quarters, therefore, there was a surplus in 1922 of 165,585 crowns, as against a deficit in 1921 of 217,285 crowns.—*Commerce Reports.*

Uruguay.—Cable Rights.—Mr. E. A. Cleugh, H.M. Vice-Consul at Montevideo, in the course of a report to the Department of Overseas Trade on the economic and financial conditions of Uruguay, points out that the country is served by the Western Telegraph Co. and the All America Cables, Incorporated. During the year an arrangement was come to whereby the former company is to abrogate its exclusive rights in Argentina, Brazil, and Uruguay in return for the abrogation by the latter company of its exclusive rights in Colombia, Ecuador, and Peru. An Italian cable to South America has also been projected, but nothing further has been heard of it recently. The contract for the establishment of a subterranean telephone system in Montevideo is also suspended for the time being. Recent modifications of the rigid laws governing the installation of radio-telephone and telegraph stations have made broadcasting possible, thereby opening a new market for radio-telephone receiving apparatus.

RADIO-TELEGRAPHY AND TELEPHONY.

Radio-Broadcasting.—Test in Coal Mine.—A test of the receiving of speech and music by radio in a coal mine was carried out on Tuesday night last by Messrs. W. A. C. Smith, Ltd., Glasgow, at the Dykehead Colliery, Larkhall, and was attended by considerable success. An Ethophone 4-valve set was fitted on a wagon which was placed on the cage. As the cage was lowered, tests were carried out at various depths. Near the surface results were poor, but as the depth increased the signals became louder up to a depth of about 180 ft. As the cage was lowered beyond this point, the signals became weaker. In one of the galleries, at a depth of 330 ft., the signals, although strong, were much distorted. Both speech and music, however, were quite intelligible. Further tests will be carried out.

Committee of Inquiry.—The Broadcasting Committee appointed by the Postmaster-General met again this week, Sir Frederick Sykes presiding. Evidence was given on behalf of the Radio Association by Mr. Samuel Landman, hon. secretary, and Major J. H. Beaumont, a member of the executive. These witnesses stated the views of the association, which represents the non-technical listeners.—*The Times.*

Society of Authors.—Broadcasting was the chief subject discussed at the annual meeting of the Incorporated Society of Authors, Playwrights, and Composers when the chairman pointed out that the Society had parted company with the theatrical managers who wanted to stifle broadcasting. The Society would help the B.B. Co. if it paid a reasonable fee.

Radio Traffic Control.—Successful Experiment.—The Metropolitan Police authorities have reason to congratulate themselves on the results of their first experiment in controlling the road traffic to Epsom Downs by means of wireless communication between a fixed post on the racecourse, a mobile post in a police tender on the road, and an aeroplane. The work was under the supervision of Lieutenant-Colonel P. R. Laurie, head of the Traffic Department of Scotland Yard, and Major T. H. Vitty, the engineering surveyor, and it is understood that the system will be further tested.—*The Times.*

U.S.A.—"Wired Wireless."—The Pacific Gas & Electric Co. has put into successful operation what is known as the "directed wireless system of dispatching." According to the *Journal of Electricity and Western Industry*, messages were transmitted between the Vaca-Dixon sub-station, near Vacaville, to the Pit River power house, some 200 miles apart. Specially constructed 500-watt sending sets and standard Kennedy universal receivers were used. Sound waves are transmitted to the high-voltage power lines and follow the course of the steel tower lines in a straight line due north 120 miles from Vaca-Dixon to Cottonwood, thence on a right-angle turn going 80 miles into the Pit region. Tests were made at from 10,300 to 23,000 metres. The energy is not broadcast, but travels in the vicinity of the transmission lines, and will not interfere with other sending or receiving stations. It is claimed that this is the longest system of its kind ever operated. It will be used for transmitting messages between power houses in the mountains and large centres of distribution, and will be especially valuable in maintaining continuity of service during heavy storms when other systems of communication are unavailable. The tests were made under the direction of Mr. J. P. Jollyman, chief of the division of hydro-electric and transmission engineering of the Pacific Gas and Electric Co. A similar "wired wireless" system of dispatching has been in operation for several months on the lines of the Great Western Power Co. between San Francisco and one of the company's main power houses at Caribou, on the Feather River, a distance of 168 miles.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared in our advertisement pages.)*

OPEN.

Australia.—Brisbane.—July 31st. Postmaster-General's Department. Cable terminals.*

Sydney (N.S.W.).—July 23rd. Department of Public Works. Pumping machinery for the Glen Mines (N.S.W.) water supply, including electrically-driven pumps, switchgear, transformers, cables, and wiring, &c.*

Melbourne. — August 7th. Postmaster-General's Department. Telephone switchboards.*

Belgium.—June 22nd. Municipal authorities of Guygoven (Province of Limburg). Establishment of a l.p. electricity system in the town. Particulars (15 fr.).

Municipal authorities of Ixelles, Brussels, are inviting tenders for l.p. armoured cables.

Birmingham.—July 2nd. Salvage and Stables Committee. Installation of electric lighting and one 5-wire balancer set for the salvage works at Witton; one 5-wire balancer set for the Montague Street destructor works. (See this issue.)

Bristol.—July 2nd. Docks Committee. Two 2-ton movable electric jib cranes. Mr. T. A. Peace, Chief Engineer's Office, Avonmouth Docks, Bristol.

Canada.—Messrs. David Spencer, Ltd., of Vancouver, invite tenders for electrical lighting and power plant installation, approximately 1,000 kW, for their large departmental store.*

Dumfries.—June 19th. Joint Sanatorium Board. Electric lighting, &c., plant and fittings for the sanatorium at Lochmaben. Mr. W. Arnott, electrical engineer, 163, Hope Street, Glasgow.

Dublin.—June 26th. Housing and Workshops Supplies Committee. Electric wiring of 332 houses at Fairbrother's Field, Dublin. Specification from the City Electrical Engineer.

Dundee.—June 21st. Electricity Department. Two- and three-core and multi-core l.p. cable. (See this issue.)

Eccles.—June 25th. Electricity Committee. Single-phase a.c. watt-hour meters for 12 months. (June 8th.)

Edinburgh.—June 25th. Electricity Supply Department. Three 3-phase transformers, e.h.p. and l.p. switchgear for sub-stations. (See this issue.)

Glasgow.—June 18th. Corporation. Electric lighting installation for the Hawthorn Street housing scheme. Mr. R. B. Mitchell, 75, Waterloo Street.

July 30th. Electricity Department. Two 15,000-kW turbo-alternators and condensing plant, boiler house plant (eight boilers, economisers and accessories), h.p. switchgear. (See this issue.)

Grimsby.—July 2nd. Electricity Department. Two water-tube boilers, with economisers, stokers, steel chimney, &c., one 1,000-kW converter, one 250-kW converter, l.p. switchgear, cables, &c. (June 8th.)

Leeds.—July 2nd. Electricity Department. Single-phase and 3-phase, Scott-connected transformers. (June 1st.)

July 31st. Electricity Department. 10,000-kW steam turbine, three-phase alternator and exciter, and auxiliaries for surface-condensing plant. (June 8th.)

June 20th. Education Committee. Electric lighting of schools. Architect's Section, Education Offices, Calverley Street, Leeds.

London.—Lambeth.—June 19th. Board of Guardians. Wiring for electric lighting and fittings at the Lambeth Hospital, Brook Street, S.E. Mr. J. L. Goldspink, Clerk to the Guardians, Brook Street, Kennington Road, S.E.11.

Leyton, E.—June 26th. Education Committee. Electric lighting installation (about 90 points), Canterbury Road Boys' School. Mr. J. H. Jacques, architect, 61, West Ham Lane, Stratford, E.

Manchester.—June 18th. Rivers Committee. Electric lighting installation at the Davyhulme sewage works. Secretary of the Rivers Committee, Town Hall, Manchester.

Penkridge (Staffs.).—July 5th. Stafford County Education Committee. Installation of electric lighting at the Farm Institute. (See this issue.)

Portsmouth.—July 3rd. Tramways Committee. Stores for 12 months, including electrical items. (June 8th.)

Rhyl.—June 19th. Electricity Department. Two 300-kW motor converter or rotary sets, one 150-kW do., do., h.p. and l.p. switchgear, and alterations to l.p. board. (See this issue.)

Salford.—July 2nd. Electricity Committee. 33,000-V cables, nine 6,000-kV single-phase transformers, and one spare ditto; coal-conveying and ash-removal plant. (See this issue.)

South Africa.—Windhoek.—June 30th. Municipal Council. Storage battery and equalising booster.*

Southend-on-Sea.—Light Railways and Electric Lighting Department. One steel surface tramcar traverser, one tower wagon (petrol or electrically driven), 10,000 tons of coal. (June 1st.)

Tunbridge Wells.—June 23rd. Electricity Department. Water-tube boilers, stokers, and economisers; e.h.p. and l.p. 3-phase switchboards; Scott-connected and 3-phase transformers; two 1,000-kW turbo-alternators, with condensers, and air filters; steam, feed, exhaust, circulating, and drain-pipework. (June 8th.)

Uruguay.—Montevideo.—July 12th. State Electric Light Works. General stores.*

Warrington.—June 26th. Electricity Department. H. and l.p. cable. (June 8th.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Bolton.—Tramways Committee. Accepted:—
40 tramcar controllers.—English Electric Co., Ltd.

Public Health Committee. Accepted:—
Installing electric wiring and fittings at the Borough Hospital.—Corporation Electric Fittings Department.

Bury.—The following contracts have been placed in connection with the Chamber Hall power station, *viz.*:—
Engine-house floor girders.—John Booth & Sons.
Water pipes for the new 10,000-kW turbo-alternator.—Brightside Foundry and Engineering Co.

Canterbury.—Town Council. Accepted:—
Water intake at the electricity works (£1,648).—H. C. Fullar & Co.

Dover.—Town Council. Accepted:—
New plant for the electricity works (£24,838).—English Electric Co., Ltd.

Edinburgh.—Lord Provost's Committee. Accepted:—
24 air-brake equipments to be used on cars in the northern part of the city.—British Air-Brake Equipment Co.

Glasgow.—Housing Committee. Recommended:—
Electrical installation at Cathcart Road housing scheme (£537).—White, Thomson & Co.

Electricity Committee. Recommended:—
Bridge widening scheme at the Corporation's Dalmarnock power station (£28,229).—P. & W. Anderson, Ltd.

London.—Hackney.—Electricity Committee. Recommended:—
Extractor, motor pump and connections (£300).—Hick, Hargreaves & Co., Ltd.

Macclesfield.—Town Council. Accepted:—
Two dynamos, booster, switchboard, and accumulators for the sewage works (£638).—R. M. Carr.

Matlock.—National Association of Local Government Officers. Accepted:—
Installing electric light at convalescent home.—Bradleys, Ltd., Bolton.

Stafford.—Electricity Committee. Accepted:—
1,000-kW rotary-converter at the electricity works (£3,553).—English Electric Co., Ltd.

Salisbury.—Town Council. Accepted:—
Installing electric light at the Council House (£117).—Mr. A. Higginbotham.

South Africa.—Railway Electrification.—The following additional contracts have been placed:—
88,000-volt transmission line.—Hubert Davies & Co., Ltd., of Johannesburg.
Coal- and Ash-handling plant for power station.—Robert Dempster and Sons, Ltd.
Circulating-water pipes.—J. Blakeborough & Sons, Ltd.
Circulating screening plant.—Babcock & Wilcox, Ltd.

Johannesburg.—Town Council. Recommended:—
5,000 yd. electric cable (£1,372).—Telegraph Manufacturing Co.
500 27-ft. steel lighting poles (£2,533); and 250 steel tram poles (£4,088).—Allen, Wack & Shepherd, Ltd.
2,000 tie bars (£767).—Blane & Co., Ltd.
100 27-ft. steel lighting poles (£500).—Hubert Davies & Co., Ltd.
20 sets double motor bogie trucks (£7,880).—Blane & Co., Ltd.
20 sets of electrical equipment (£21,200).—South African General Electric Co., Ltd.—*S.A. Mining and Engineering Journal.*

Torquay.—Contracts in connection with the power station at Newton Abbot:—
15-ton travelling engine-room crane (£465).—J. Smith, Ltd.
Steel work and buildings (£8,898).—Matthews & Mumby.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Saturday, June 16th. At Albemarle Street, W. At 3 p.m. Lecture on "Atomic Projectiles and their Properties," by Sir Ernest Rutherford, F.R.S.

Institution of Engineering Inspection.—Wednesday, July 18th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Paper on "Molecules, Atoms, and Electrons," by Mr. R. P. Wilson.

Incorporated Municipal Electrical Association.—June 18th to 23rd. At Scarborough. Annual Convention.

Institution of Heating and Ventilating Engineers.—Tuesday, June 19th. At the Grand Hotel, Folkestone. Summer meeting.

Tramways and Light Railways Association.—Thursday and Friday, June 21st and 22nd. At the Hotel Metropole, Swansea. Annual Congress.

Chemical Society.—Thursday, June 21st. At Burlington House, Piccadilly, W. Ordinary scientific meeting.

Physical Society of London.—Friday, June 22nd. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Lecture by Prof. F. Horton.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

We have to remind readers that Service Department inquiries should be accompanied by a stamped addressed envelope.

The letter of Mr. F. V. Wood (Repulsion Motors) contains no address. If he will write us again we shall be pleased to advise him.

NOTES.

Revival of the Batti-Wallahs.—To use the words of the secretary, Mr. M. Whitgift, "Now that the backwash of the war has left the good ship Batti-Wallah afloat and seaworthy," many of the old activities of the Batti-Wallahs' Society are to be resumed. At the meeting held in April, Mr. Edgar Barralet was elected president for 1923, with Mr. A. J. Greenly as vice-president and Mr. Whitgift (7, Coulter Road, Hammersmith, W.6) as hon. secretary. It was decided not to hold the annual dinner this season, but it has been decided to revive the association with the sea. There is to be a summer outing, a riverside garden fête in August, and a visit to a new super-liner in the late autumn. On June 30th the Society visits the first motor-boat racing and regatta to be held above bridges on the Thames. A launch will pick up visitors at Westminster Pier, leaving at 1 o'clock sharp for moorings adjoining the British Motor Boat Club's boat at Chelsea. Luncheon and tea will be served on board, and inclusive tickets are 17s. 6d. each for members and men friends, and 12s. 6d. for ladies. Immediately after the races the launch will proceed to Richmond, where dinner tables will be reserved at the Castle Hotel as required.

Electric Washers in the United States.—The Utah Power and Light Co. during March last sold 1,120 washing machines. Easy terms of $1 down and $5 a month were offered, and proved very attractive to customers, and the 30-day campaign was carried out by 35 persons, with the aid of a liberal amount of advertising.—*Electrical World.*

Appointments Vacant.—Shift engineer (£440), for the Government of Nigeria Electric Light Department; visiting teachers of mathematics, mechanical engineering, and electrical engineering, for the Paddington Technical Institute; senior switchboard attendant and relief shift engineer, for the Rawtenstall Corporation electricity department; engineer-in-Charge (£250), for the Borough of Bermondsey electricity department; e.h.p. plumber-jointer (75s.), for the Wolverhampton Corporation electricity department; foreman mechanic (£308), for the Sudan Government Posts and Telegraph Department. (See our advertisement pages to-day.)

(*Continued on page* 943.)

THE INSTITUTION OF ELECTRICAL ENGINEERS ON TOUR.

Summer Meeting in Lancashire and North Wales.

(*Continued from page* 898.)

In the morning of the second day of the meeting, June 6th, special tramcars conveyed the visitors to the Pomona Docks, where they embarked on two large steam tugs, as the guests of the Manchester Ship Canal Co., and proceeded down the canal, viewing the swing bridges, locks, and engineering features *en route*. The dock equipment includes hydraulic, steam, and 130 electric cranes capable of lifting from one to seven tons, as well as six electric grab cranes having a capacity of 5 tons each, while at the Eastham lay-bye electrically-driven shear legs of 150 tons capacity are provided for lifting and replacing the tops of masts and funnels.

The party disembarked at Barton and inspected the Manchester Corporation's new electricity generating station, which serves part of the South-East Lancashire Electricity District. It is the fourth station owned by the Corporation, and we hope to describe it next week.

The Barton site is capable of eventually accommodating 150,000 kW of plant, but certain limiting factors may preclude the development of that total.

Amongst the alternative visits which had been arranged for the benefit of individual members was one to the 33,000-volt outdoor substation of the Corporation in Chorlton-on-Medlock, which is claimed to be the first large example of its kind in this country. All the oil switches, supplied by the B.T.H. Co., have a breaking capacity of 500,000 kVA, and are remotely-controlled, being operated by single-phase 240-volt motors, the operating circuits and a few emergency lights being supplied by two 50-Ah 60-cell Chloride batteries.

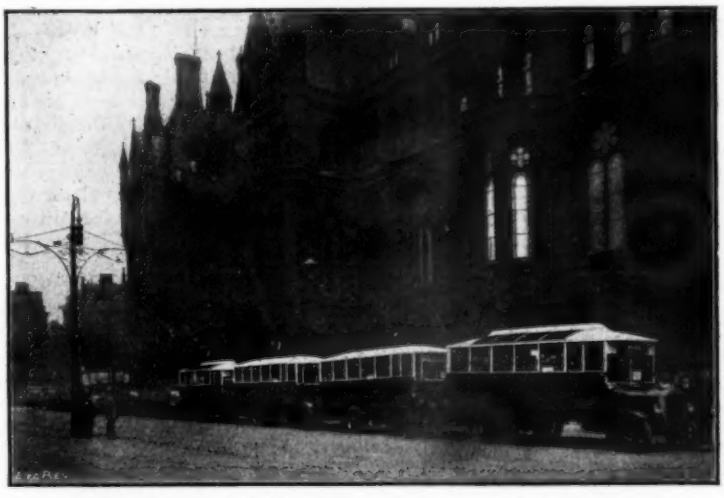


Fig. 1.—Departure from Manchester Town Hall for Clifton Junction; Coaches Furnished by Lancashire United Tramways, Ltd.

The 33,000-volt duplicate bus-bars and isolating switches are mounted above a central gangway, mechanical operating gear being provided for the isolators. The bus-bars and conductors are made of 1¼-in. diameter copper tubing and coned couplings are employed for all joints and connections, thus maintaining a circular outline to reduce the corona discharge. The supporting structure is of reinforced concrete, and all the other apparatus is mounted on concrete plinths at ground level. The oil switches are of the tank type, with compound-filled bushings and explosion chamber contacts. The chambers consist of an inverted steel cup, lined with insulating material, fitted over the contacts and their function is to minimise the stress in the main tank sides and to assist in rapidly extinguishing the arc when the switch opens.

Non-corrodible bearing pins are used throughout, and all iron and steel that is exposed to the weather is galvanised or sherardised. Lightning arresters of the oxide-film type, with sphere gaps, are used for each transformer group.

The 6,600-volt switchgear is of the concrete cubicle type, the H-type oil switches having two separate steel tanks per phase. Auxiliary busbars are designed so that any feeder can be kept in service whilst its switchgear is "dead" for cleaning or other purposes.

There are three 8,500-kVA transformer groups, each comprising three single-phase, outdoor, oil-immersed, self-cooled, 33,000/6,600-V transformers supplied by the Metropolitan-Vickers Electrical Co., Ltd. Each transformer is provided with a conservator tank, chloride breather, and a distance electrical thermometer, the indicators being mounted in the control room.

Two 125-kVA, 6,600/420-V, 3-phase, oil-immersed, self-cooled transformers supply the oil switch closing circuits and motor generators, and also energy for battery charging, station lighting, and for local distribution. A 428-kVA, oil-immersed, self-cooled, induction regulator having a pressure range of from 6,270

Fig. 2.—Tea at the Chloride Battery Works.

to 6,930 volts is used in conjunction with each main transformer group; they were supplied by the Oerlikon Co., Ltd., and are non-automatic, but have electrically-controlled, 3-phase, 420-V operating motors; double units are used to correct phase displacement.

Members were then conveyed in charabancs from Barton to Trafford Park, where luncheon was provided by the Metropolitan-Vickers Electrical Co., Ltd., and the remainder of the afternoon was devoted to a tour of the works, which cover 130 acres, and the effective floor space in the shops amounts to 1,500,000 sq. ft. The normal number of employés is about 9,000, and the generating station which supplies power to the works has a normal capacity of 4,000 kW.

During the afternoon a number of members also paid a visit to the works of the Lancashire Dynamo and Motor Co., Ltd., at Trafford Park that extend over an area of some 150,000 sq. yards. There are about 1,000 employés, and the manufactures comprise a.c. and d.c. generators and motors up to about 1,500 kW in size, and turbo-alternators up to 5,000 kW; in addition, various combinations of motors and generators are built to operate as balancers, boosters, and motor generators. Both these works will be referred to again next week.

After tea, which was provided at both works, members returned to Manchester by special tramcars and motor-charabancs, and, as an alternative to the works visits, facilities were provided for those who wished to do so to attend the Northern Lawn Tennis Club, where the North of England open championships were being played. During the evening a reception at the Victoria University (Whitworth Hall) was held by Sir H. A. Miers, Vice-Chancellor.

The Laboratories were open for inspection on the Wednesday morning; the laboratories contain over 50 machines of representative types, many of which have been specially designed and all of which are set apart for purely experimental purposes. To many local firms, particularly Messrs. Mather & Platt and the Metropolitan-Vickers Electrical Co., the Department is indebted for valuable contributions towards the equipment of the laboratories. The courses of lectures, extending over three sessions, lead to the pass and honours degree of B.Sc. in engineering, and during the past few years the average number of engineering students attending courses in this subject has been about one hundred.

The investigations conducted in the Electro-technical Department since its inauguration have chiefly had reference to applied magnetism and alternating-current measurements. The Department has also participated in industrial research.

In the Municipal College of Technology the courses provided by the college lead to the degrees of B.Sc. and M.Sc. The work is laid out particularly to meet the special technical requirements of students and apprentices in this highly-industrial area, and, in addition to about 500 day students, the college is attended by nearly 5,000 part-time (day and evening) students.

The Electrical Standardising Laboratory is equipped for the measurement of electrical quantities over a wide range. The High-voltage Laboratory is furnished with plant mainly for teaching and research. It is also employed for occasional commercial tests.

Work in radio-communication is carried out, and the College station (5PQ) has six different aerials. The receiving equipment varies from a simple crystal circuit to a 9-valve c.m. coupled circuit, with a wave-length variation from 300 to 28,000 metres; seven methods of transmission can be employed.

During the stay in Manchester individual members who wished to do so were given an opportunity of visiting the offices of the *Manchester Guardian* to view the rotary printing presses and other machinery. It was established in 1821, and began its career as a weekly journal, but in 1855 it began to be issued daily. About 1868 it obtained its private wire to London, and all the news between the two cities is transmitted by means of the Murray multiplex telegraph machine at high speed. *(To be continued.)*

THE LANCASHIRE ELECTRIC POWER COMPANY.

The Radcliffe Generating Station.

The above-named company commenced to supply electricity 18 years ago from its Radcliffe generating station, which was visited by members of the Institution of Electrical Engineers during the first day of the Summer Meeting; it is one of the ten largest undertakings in this country, whilst in respect of the efficiency of its power station it has attained a standard that it may well be proud of. The capacity of its generating plant now amounts to 42,375 kW, the maximum load having reached 35,000 kW, the connections to the mains 49,000 kW, and the output 100 million kWh per annum. Fig. 1 is an exterior view of the station. It is built upon a reinforced-concrete raft on a site between the River Irwell and the foot of a high, steep hill, and no part of it is underground.

From the railway sidings connected with the main Lancashire and Yorkshire section of the L., M. & S. Rly., on the top of the above-mentioned hill, which is on a level with the roof of the generating station, coal is conveyed automatically into the bunkers by gravity. The loaded coal wagons are hauled a short distance from the railway sidings by an electric locomotive, along a gantry parallel to the station (fig. 4); each wagon is tipped by an electrically-operated ram (fig. 7), its contents falling into one of two steel bunkers, terminating in shoots and coal valves, located centrally over a double runway track that serves the newer portion of the boiler house. There are three runways on which travel steel trucks capable of holding 25 cwt. of coal each; as each truck is filled from the bunker shoot it is released from the holding dogs and runs down an incline towards the boiler house (fig. 5) by gravity, gathering speed until it reaches a barrier across the rails (which can be seen in fig. 4) connected to a heavy pendulum by wire ropes. The truck picks up the barrier and carries it along, thus raising the pendulum, with the result that the speed of the truck is diminished, it stops inside the boiler house, tips its contents into the bunkers, and the return swing of the pendulum then drives the truck back again to its starting point.

The whole of the coal-handling plant was supplied by Messrs. Babcock & Wilcox, Ltd.; it deals at present with about 7,000 tons of fuel per month, and the whole operation is performed without noise or shock, no labour, except that of the man at the loading point, being employed. Fig. 6 is a view of one of the newer firing aisles, while fig. 2 shows a portion of the newest section of the boiler house in which overhead coal bunkers have not yet been provided; consequently the fuel is delivered to the stoker hoppers by small side-dumping trucks which run along the boiler fronts and are filled from bunker shoots in the next bay.

The ash is removed and deposited on adjacent land by means of a ropeway of the jigback type, the rope being reversed for each journey made by the buckets.

The boiler house (figs. 2 and 6) consists of four firing aisles, and has been equipped throughout by Messrs. Babcock & Wilcox, Ltd.; it contains 24 land-type boilers, each (except the six originally installed) rated at 30,000 lb. of steam per hour. The Green economisers are placed above the boilers. The working steam pressure is 160 lb. per sq. in., with a superheat

of 150 deg., and a final temperature of 520 deg. F., these comparatively low figures being adhered to in order to avoid the complications that would arise were the new plant to differ from the old. The quality of the fuel available has rendered the provision of forced-draught plant unnecessary, one electrically-driven induced-draught fan and a short steel stack sufficing for each "unit" of two complete boilers.

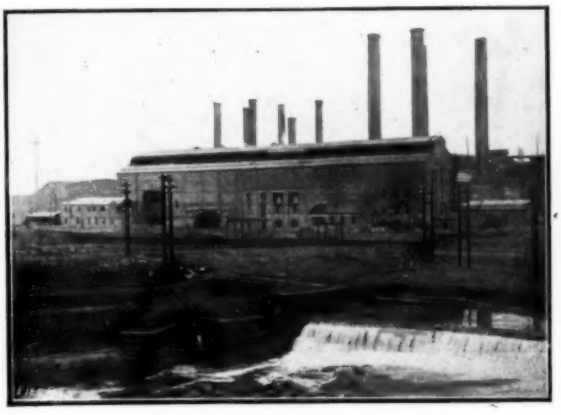


Fig. 1.—Radcliffe Power Station.

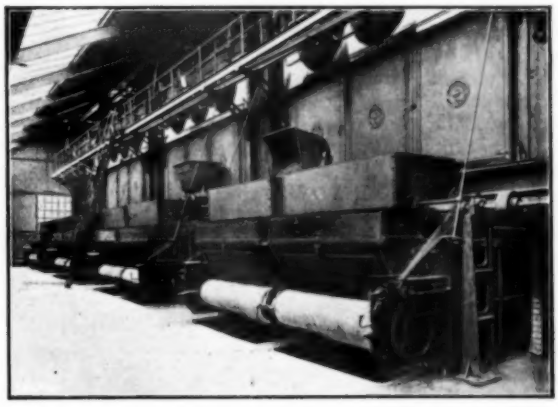


Fig. 2.—New Boilers.

The whole of the generating plant and all the motors used in the station were supplied by the British Thomson-Houston Co., Ltd.; fig. 3 is a view of the turbine room showing the six main sets, the four original vertical sets not being shown; the capacities of the machines in the order in which they were added are: one 2,500, one 3,500, one 4,375, one 6,000, and two 10,000-kW. The last two turbines are standard multi-stage impulse machines running at a speed of 1,500 r.p.m., and are coupled direct to standard 3-phase, 50-cycle, 11,000-volt generators, each of which is able to deliver 13,333 kVA normally or to carry a 25 per cent. overload for two hours. The best efficiency ratio of 73.8 per cent. occurs at ¾ load, with a steam consumption of 12.13 lb. per kWh produced. The generators are provided with circulating current protective gear and automatic field-suppression switches.

The surface condensing plant was supplied by Messrs. Worthington-Simpson, Ltd., each condenser maintaining a vacuum of 28.5 in. with the barometer at 30 in. when supplied with cooling water at a temperature of 65 deg. F. and dealing with 130,000 lb. of steam per hour. The main feature of the auxiliaries is that each condenser is provided with duplicate plant, either set being capable of maintaining the required vacuum at loads up to 60 per cent. of the full load. One set of auxiliary plant is driven by a.c. motors fed from the station bus-bars and the other by d.c. motors fed from independent house generating plant, which also provides the station lighting, &c. The air pumps are of the Worthington hydraulic rotary type with centrifugal operating pumps, and the water-circulating pumps are each capable of delivering 9,200 gallons per minute at a speed of 340 r.p.m.; the capacity of the latter enables one pump to do the work when the water is colder than usual. The River Irwell furnishes an

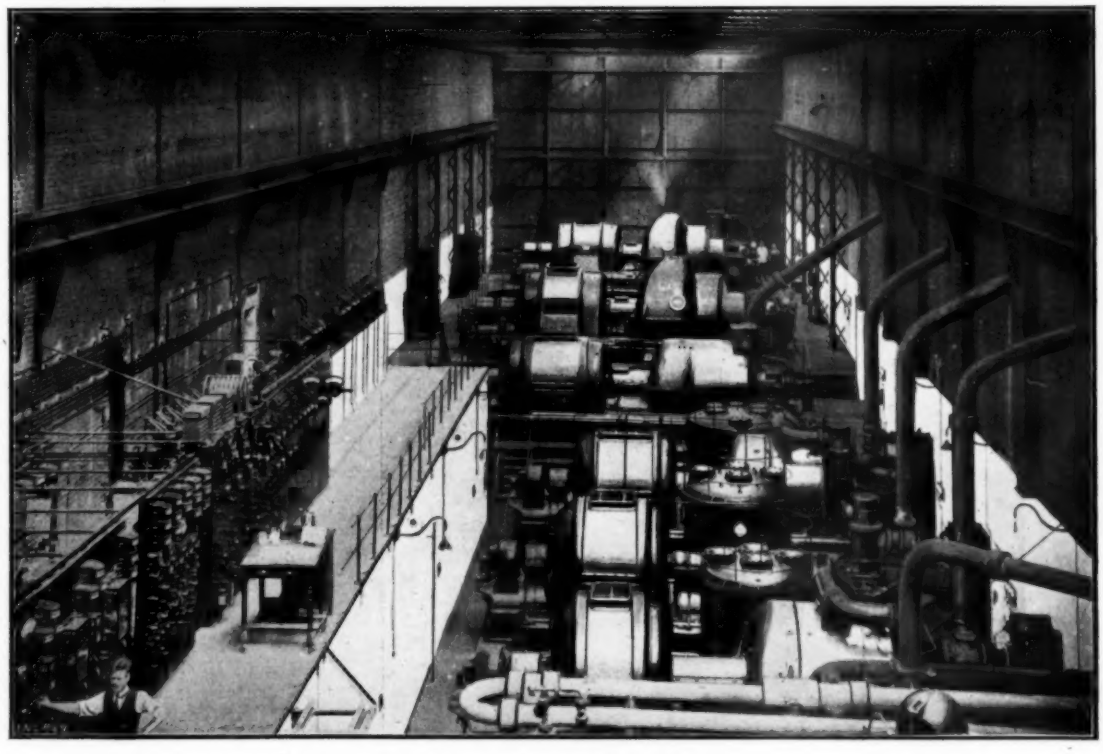


Fig. 3.—Turbo-Generator Room.

ample supply of water, which is drawn through revolving circular flat screens, electrically driven.

All the switchgear was supplied by the British Thomson-Houston Co., Ltd.; the 11,000-volt generated pressure is applied direct to the generator bus-bars, which are divided into two sections, interconnected by reactance and protected with electrolytic lightning arresters in each section. Two group feeders are connected through isolating switches to each section of the generator bus-bars, each group supplying six feeders, there being 24 outgoing feeders. Each consumer on the system has an alternative source of supply, so that in the event of a fault one feeder can be changed over to another, provision also having been made for connecting any feeder through a test reactance when desired. The switchgear is of the cellular motor-controlled spring-operated type. The feeders are provided with inverse time-limit overload relays and instantaneous earth leakage relays, while special discriminating gear protects parallel feeders.

Finally, a word may be said about operating results. Notwithstanding the low steam pressure and temperature employed at Radcliffe, the Electricity Commissioners' returns for the year ended March 31st, 1922, indicated that in respect of coal consumption and thermal efficiency the Radcliffe station was third amongst stations of all sizes in Great Britain and first in the South-East Lancashire area. But the results have since been improved upon, and for the year ended March 31st, 1923, its thermal efficiency was 15.72 per cent. and the fuel consumption 1.802 lb. per kWh generated, or 1.857 lb. per kWh delivered to the feeders. Again, attention must be directed to the low percentage of the total power generated which is used in the station; for months at a stretch nearly 97 per cent. of the total electricity generated has been delivered to the feeders, and this figure is expected to reach 98.36 per cent. when the two largest generating sets are carrying the full load regularly. It is also worthy of note that every saleable kWh was produced for the evaporation of only 14.33 lb. of water in the boilers—an extraordinarily low figure which reflects great credit upon Mr. C. D. Taite, M.I.E.E., the company's engineer and manager, and his staff, to whom we are indebted for assistance in the preparation of this article. The British Thomson-Houston Co., Ltd., and Messrs. Babcock & Wilcox, Ltd., must also be thanked for the loan of photographs from which the accompanying illustrations were reproduced.

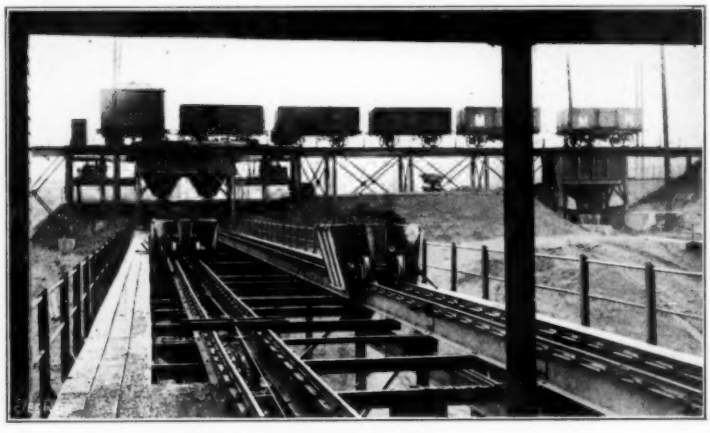


FIG. 4.—AUTOMATIC COAL RUNWAY.

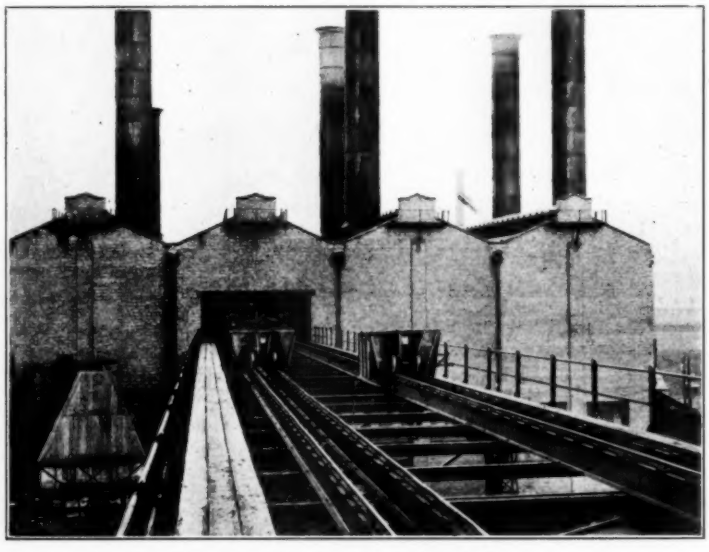


FIG. 5.—AUTOMATIC COAL RUNWAY.

FIG. 6.—BOILER HOUSE FIRING AISLE.

The company operates under three Acts of Parliament passed in 1900, 1904, and 1906 respectively, and its territory of about 1,100 sq. miles is served by a network of 10,000-volt trunk mains. The original plant consisted of six 160-lb. pressure, 20,000-lb. capacity, Babcock & Wilcox land-type boilers and four vertical B.T.-H.-Curtis 1,500-kW, 50-cycle, 3-phase, 10,000-volt turbo-generators, this pressure being the highest used in this country at that time; it was chosen with a view to long-distance transmission, overhead mains being the rule rather than the exception in the early days of the undertaking. The

company has interconnecting agreements with other undertakings in South-East Lancashire, and is at present laying 33,000-volt interlinking mains between its Radcliffe station and the new Barton station of the Manchester Corporation. An order for a third 10,000-kW generating set has been placed with the British Thomson-Houston Co., Ltd.

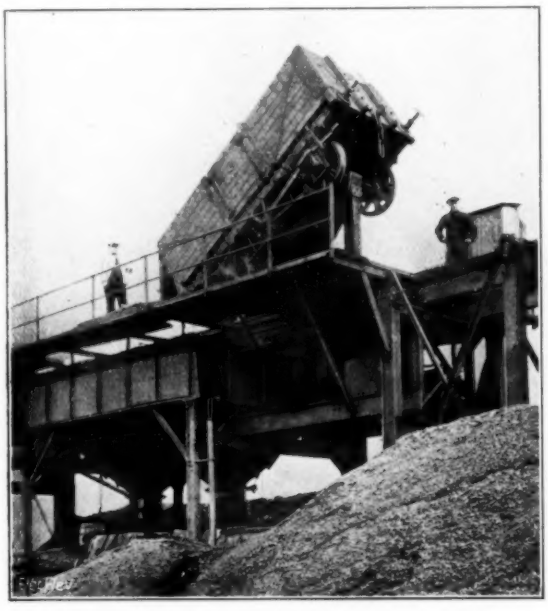


Fig. 7.—Coal Wagon Tippler.

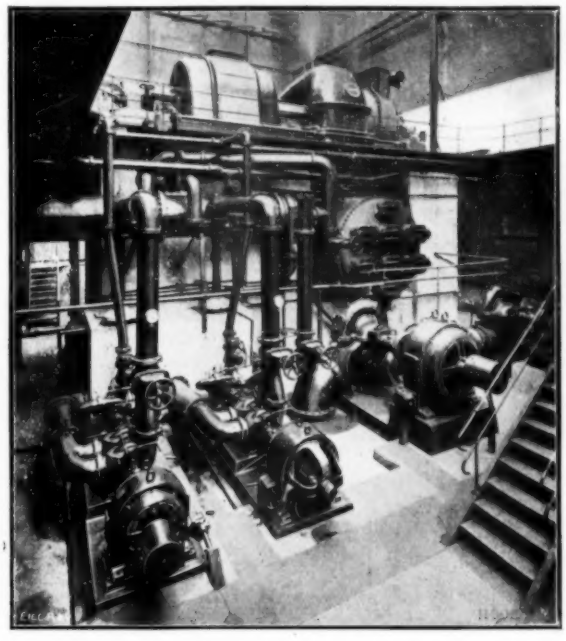


Fig. 8.—Condenser and Auxiliaries.

AN ELECTRICALLY-DRIVEN WIRE ROD MILL.

Messrs. Richard Johnson & Nephew's Works.

Members of the Institution of Electrical Engineers on June 5th visited the Bradford Ironworks of Messrs. Richard Johnson & Nephew, Ltd., wire drawers, of Manchester, for the purpose of inspecting their electrically-driven wire rod mill. The firm has been established over 150 years, and has from the advent of the electric telegraph been closely associated with all classes of wire for this service, both for land lines and submarine enterprises.

Here was the birthplace, in 1860, of the continuous system of galvanising, a system which has been adopted in every galvanising wire works in the world. In 1862 the patent was taken out here for the continuous wire rod rolling mill, which produced unprecedentedly long lengths of wire for telegraph and cable installations. In 1864 the style of the firm became Richard Johnson & Nephew, and since then copper-rolling and wire-drawing plant has been added to meet the increasing requirements of the electrical industry. In all departments electricity has completely superseded steam; and in its latest development the firm has built a continuous wire rod rolling mill of a unique character where the motive power is electrical. It is a new plant of very considerable interest for dealing with large outputs of wire rod of various sizes, but mainly of No. 5 and No. 6 gauge.

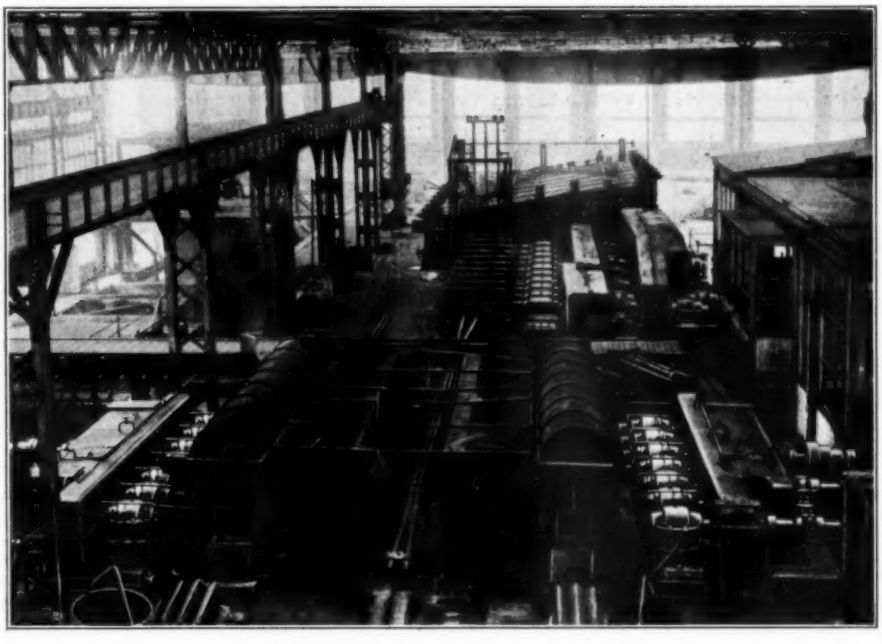


Fig. 1.—Heating Furnace and Mill.

An entirely new shop, approximately 560 ft. long

by 190 ft. broad, has been equipped with modern devices for handling a large output of finished material. Fig. 1 shows the centre and left-hand bay at the incoming end of the mill, from which the general lay-out of the heating furnace and mill is clearly seen.

The heating furnace, which lies immediately in front of the roughing train of the mill, is of the continuous type and is designed for 20 tons of billets 2 in. square by 28 ft. long per hour. It is gas-fired, the gas being supplied from producers of the revolving grate type built below the mill ground level, as seen on the left-hand side of fig. 1.

The mill is of the continuous type and is divided into a roughing train with ten stands and two finishing trains, each with seven stands of rolls. Two billets, issuing together from the furnace, enter the roughing mill simultaneously and are carried by two leading-out pipes to the remote end of the two finishing stands, where one piece is returned to the right-hand and the other to the left-hand finishing mills.

As the finished wire rod comes from the rolls, it is caught by revolving drums which coil the rod, the coils being deposited by an hydraulic pusher on to a transverse conveyor which, in turn, leaves them on a conveyor running the length of the shop, which carries them to the unloading bank. The operation is normally automatic from beginning to end, no manual handling whatever taking place at any stage of the process.

The mill and furnace were designed by Mr. Jos. Phillips Bedson, M.Inst.C.E., late general manager of Messrs. Richard Johnson & Nephew, Ltd., son of the late George Bedson, of Manchester, who brought out in 1862 the original patent for the continuous system of wire rod rolling. The mill can roll a 2-in. billet, 28 ft. long, weighing 364 lb., to a No. 6 wire rod in a minute, and can finish two such rods at one and the same time and, if need be, in two different sizes. In this the mill is unique. Further, the gearing of the mill is of the machine-cut, double-helical type, in cast steel, which represents an important advance, as in the past bevel gearing has been used. Consequently, the efficiency of the gear is very high.

The whole of the lay-out and erection of the furnace and electrical equipment was carried out by Mr. Bedson's son, Mr. N. P. Bedson, B.Sc., A.M.Inst.C.E., M.I.E.E.

The roughing and two finishing mills are each separately driven by constant-speed 3-phase motors, the drive being through double-helical gear wheels running in an oil bath. The speed of the motors corresponds to the speed of one of the pairs of rolls, and the ratio of the wheels is such that the speed of the successive rolls is in the correct relationship with the varying speed of the metal. The roughing-mill driving motor is of 2,750-h.p. continuous output on a 6,600-volt, 3-phase, 50-cycle supply at a speed of 500 r.p.m. This motor is shown in fig. 4, together with the barring motor behind it, which is used for setting the rolls. The over-running clutch between the two automatically throws the barring motor out of gear when the speed of the main motor exceeds that of the barring machine.

Each of the finishing mills is driven by a 750-h.p., 3-phase motor running at 750 r.p.m., the arrangement of the drive being similar to that of the roughing mill motor. Fig. 2 shows one of the motors. The complete control of the mill is carried out by operators on a platform in full view of the mill. On each side of the central motor control panel are the levers which

FIG. 3.—SUB-STATION SWITCHGEAR.

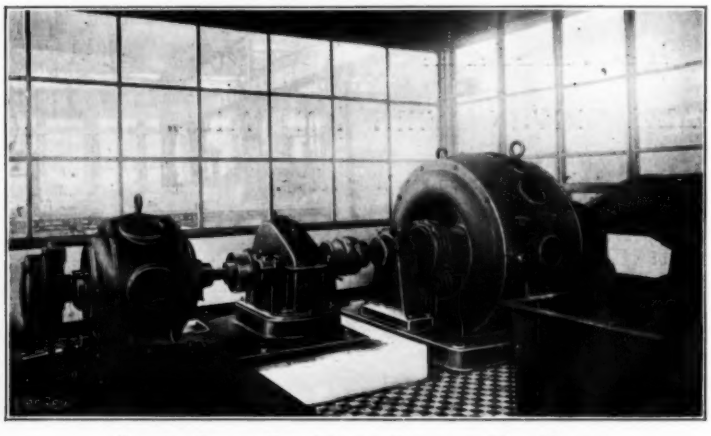


FIG. 2.—ONE OF TWO 750-H.P. FINISHING MILL MOTORS.

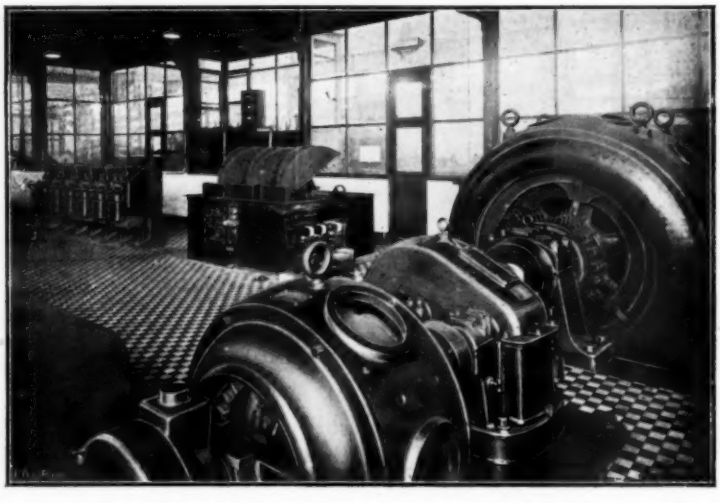


FIG. 4.—2,750-H.P. MOTOR DRIVING ROUGHING MILL, WITH SMALL BARRING MOTOR.

operate the hydraulic pushers for unshipping the finished coils on to the conveyors. The motor control panel is equipped with a "stop" and "start" push button for each motor, with an indicating lamp immediately above, and an ammeter reading the stator current between each pair of buttons.

The pressing of a "start" button energises the operating coil of the oil switch controlling the corresponding motor stator circuit, which closes, and in closing makes the circuit of an auxiliary motor attached to the starter. This runs up to speed and winds the blades of the starter into the liquid solution at a rate controlled by a current relay in the stator current of the main motor. On reaching the "full in" position of the blades, the auxiliary motor is automatically disconnected from the supply and stops. The reverse action takes place when a "stop" button is operated.

Electricity is purchased from the Manchester Corporation, and the incoming supply at 6,600 volts is dealt with in a sub-station, shown in fig. 3, which gives a good idea of the cell-type remote-controlled hand-operated switchgear. An auxiliary d.c. lighting board is provided, and the whole of the h.p. and other cable work between the sub-station and the motor houses is carried through tunnels under the works, the cables being supported by brick racks built into the sides of the tunnels. A motor-driven fan forces cooling air through the tunnels, the outlets of which are arranged underneath the motors.

The reduction gearing on the mills was supplied by Messrs. David Brown, of Huddersfield, and the electrical plant was built at the Stafford works of Messrs. Siemens Bros. Dynamo Works, Ltd., which are now amongst those controlled by the English Electric Co., Ltd.

In conclusion, we have to express our indebtedness to Mr. J. P. Bedson and to the English Electric Co., Ltd., for their assistance in the preparation of this article.

NOTES.

(*Continued from page* 936).

Annual Outing.—The eighth annual outing of the Post Office Engineering Department, Designs Section, took place on Saturday, June 9th. The party left the G.P.O. at 1 o'clock in motor charabancs, and proceeded *via* Uxbridge and Beaconsfield to Burnham Beeches, where they enjoyed a two hours' ramble through the "little chaos of mountains and precipices covered with venerable beeches and other very reverend vegetables," as it was described by the poet Gray. The party of 85 was photographed after tea, and then returned *via* Stoke Poges (where the church was visited) and Slough, the G.P.O. being reached at 9 o'clock.

Engineering Students at Sea.—While on vacation a student from the engineering faculty of Liverpool University will be carried on each White Star Line passenger steamer sailing from Liverpool to America this summer.—*Financial Times.*

Accident.—At a Liverpool sub-station, on June 2nd, an employé named Geo. Phillips was seriously burnt about the abdomen and face. While he was inspecting a power board his watch chain came into contact with a fuse and caused an explosion. He was removed to the hospital.

Inquest.—The question of regulations for "live" wires in populated areas was raised at an inquest on June 7th at Ecclesfield on Allom Greensmith, who was killed by touching a "live" wire after climbing a pole. The inquest had been adjourned on May 7th following questions raised in Parliament about the Board of Trade regulations concerning "live" wires.

The Coroner said he had communicated with the Home Secretary, and the matter had been referred to the Electricity Commissioners, who informed him that the poles and wires had not been erected under any statutory authority.

The Coroner advised the jury that in the circumstances there was no ground on which they could censure the people maintaining the wires. The wires had been up for 26 years, and it was the first accident that had occurred.

A verdict of "Death from misadventure" was returned.

Service Notes.—During the refit of the Sheerness radio-telegraph station the light cruiser *Birmingham* will carry out the duties of the station. At the dinner of the Institution of Electrical Engineers, Plymouth, last week, the guests passed a resolution of congratulation to Mr. W. McClelland, director of electrical engineering at the Admiralty, on his inclusion in the honours list, on the motion of Mr. P. A. Yapp, assistant electrical engineer at Devonport Dockyard. Commissioned Electrician T. R. Brotheridge has been posted to the light cruiser *Maidstone*, submarine depôt ship. Warrant Electrician F. L. Weatherdon has been appointed to the *Eagle*, from the 1st inst. In a new development of army training to fit men for civilian life after colour service, boys, who are usually enlisted for service as bandsmen, &c., will be enlisted for service as wireless operators and electricians. Vacancies for the above and other branches in which boys can be utilised will be filled by competitive examination. The training will be free, and while undergoing it the boys will be maintained by the army and receive pay.

Fatalities.—An Ayr pit bottomer, last week, went forward to switch on the electricity for the haulage motor of which he had charge when, for some unexplained reason, an explosion occurred and he was hurled with great force against a brick wall, receiving fatal injuries.

While working at the switchboard at Farnham electricity works, on June 11th, Richard Barham, works engineer, received a fatal electrical shock at 2,000 V.

The Leeds Tramway Accident.—Upon the conclusion of the Ministry of Transport inquiry into the Churwell Hill disaster, the Leeds City Coroner last week resumed the inquest upon those who were killed. The driver of the car, who repeated the evidence which he gave at the inquiry, stated that neither the hand brake nor the electric brake appeared to act. He was too upset to reverse his controller; he could not say whether he fell off the car or left it voluntarily before the accident occurred. Mr. Wm. Greaves, a consulting engineer, said that he had examined the brakes, of which there were ten—four block, four track, and two electric—and found the near-side magnetic brake inoperable, causing a 10 per cent. loss in braking power. The hand-brake ratchet was slightly worn. The works superintendent of the tramway department gave similar evidence, and said that he could find no indication that sand had been used. In summing up the evidence, the Coroner said that the accident was probably due to the circumstance, admitted by the driver, that the controller was not reversed when the hand-brake failed to act. Knight (the driver) had suffered in the war, and was in a state of health which would affect his initiative. There was nothing approaching criminal negligence. The jury agreed, but in returning its verdict of "Accidental Death" gave as its opinion that Knight failed in his duty in leaving the car.

Birmingham Corporation Electricity Works.—OPENING OF NECHELLS POWER STATION.—The visit to Birmingham on Tuesday last of H.R.H. the Prince of Wales aroused great enthusiasm. He was welcomed to the city at the Town Hall in the morning; next he inaugurated the new generating station at Nechells, belonging to the municipality; later he laid the foundation stone of the Hall of Memory, in honour of 12,000 Birmingham men who gave their lives in the war; after luncheon, he inspected the Boy Scouts, Cadets and men of the Legion, the Government Instructional Factory, and visited several factories, including those of the General Electric Co., Ltd., at Witton, the Dunlop Company, and the B.S.A. Co. At each place there were scenes of great enthusiasm.

At the Corporation electricity works the approaches were lined by 350 ex-Service men, other employés, and the wives and families of the employés. The ex-Service men were paraded under Col. J. W. Danielsen, D.S.O.

As his Royal Highness entered the station, the great companion set to the 15,000-kW turbo-alternator he was to start was hushed. The Prince was accompanied to a small raised platform by Alderman J. B. Burman (chairman of the Electricity Supply Committee), who had been presented by the Lord Mayor at the entrance, and who had presented Mr. R. A. Chattock (City electrical engineer) and Colonel Danielsen (chairman of the Finance Sub-Committee).

Alderman Burman presented the following members, officials and advisers of the committee:—Councillor C. T. Appleby (chairman, Works Sub-Committee), Alderman A. G. Ellaway, Alderman A. R. Jephcott, M.P., Councillors H. K. Beale, P. H. Carter, N. B. C. Dean, and J. Fryer, Messrs. E. J. Jennings (secretary), F. Forrest (chief assistant engineer), L. S. Carr (constructional engineer), W. E. Groves (mains engineer), P. R. Boulton (resident engineer), C. P. Sparks (consulting engineer), J. Alfred Harper (architect), J. S. E. de Vesian (ferro-concrete engineer), and Lieut.-Col. Anthony Rowse (quantity surveyor).

Mr. Chattock then directed the attention of the Royal visitor to the telegraph indicator which stood on the platform, with which he was to give the signal to start up the set. The Prince turned the indicator to "Stand-by," and then sounded the "Start up" bell.

The Prince was presented by Ald. Burman with a silver-gilt model of the set he had started, and a souvenir booklet descriptive of the undertaking was handed to him by Miss Winifred L. Chattock, daughter of the engineer.

The Prince walked round the turbo-alternator and asked a number of questions concerning it. Next he signed the visitors' book, and concluded his formal task by unveiling a bronze plaque commemorating his visit. He made a more detailed review of the ex-Service men as he passed to his car.

A large number of well-known engineers, chairmen of committees, &c., from all parts of the country were present at the ceremony, including Sir Harry Haward, Mr. F. Gill (president,

I.E.E.), Mr. S. L. Pearce, C.B.E., Mr. R. B. Mitchell, Mr. S. T. Allen, Sir T. O. Callender, Mr. C. R. J. Parkinson, Mr. C. H. Yeaman, Mr. J. C. Vaudrey, and Mr. W. B. Woodhouse.

An illustrated description of the power station was published in our issues of May 25th and June 1st, 1923.

During the afternoon the Prince paid a visit to the works of the General Electric Co., Ltd., at Witton.

The road approaches to the works were most effectively decorated; indeed the works were in festal garb. At the Magnet Club House the Lord Mayor (Ald. David Davis) presented Mr. H. Hirst, chairman and managing director, who in turn presented Mr. M. J. Railing, director and general manager; Dr. A. H. Railing, director and manager, Witton Works; Mr. W. H. Heaton, works manager, engineering shops; Mr. W. E. Simmons, inspector, switchgear works, an employé of 39 years' service; Mr. J. Gibson, foreman, carbon works (28 years); Mr. G. E. Goodison, operative, engineering works (27 years); Mr. W. Hulme, operative, engineering works (29 years); Mr. W. Kilner, engineering works (26 years); Mr. E. G. Oten, superintendent of the winding department (28 years); and Mrs. Matty, operative, carbon works (20 years).

C.T.S. greeting at entrance to Nechells Power Station (courtesy of Callender's Cable Co.).

The Prince starting the set, with Mr. R. A. Chattock.

Taking leave of Mr. Hugo Hirst and G.E. Co. staff at the Magnet Club.

The staff and workpeople of the company were assembled along the route and in the vicinity of the Club House, and a welcome, marked by great patriotic fervour, was accorded to the Prince. The visitors included many engaged in the electrical industry, and the Mayor and Town Clerk of Sutton Coldfield. The Prince made an inspection of 1,000 ex-Service men employed by the firm, who were ranged on a platform in front of the Recreation Ground.

His Royal Highness had a few minutes' chat with Mr. Hirst, to whom he expressed his regret that he had not had an opportunity of making an inspection of the works. He hoped to do so on some future occasion, as he had seen that day much to impress him regarding the general organisation of the works, and the good feeling existing.

Legal.—CASE SETTLED.—The case of X.G.L. Syndicate, Ltd., against London Electric Supply Corporation, Ltd., which alleged different charges to different consumers, was to have been heard by Mr. Justice Astbury in the Chancery Division on Wednesday. Mr. Luxmoore, K.C., for the plaintiffs, said he desired to relieve his Lordship of trying the case. The parties had come to terms, and he need not trouble his Lordship with them, except to say that there was an agreement for the payment of the plaintiffs' costs which were to be taxed in case the parties differed, and £100 which was paid into Court as security for costs by the plaintiffs would be released and paid out to the plaintiffs' solicitors. Mr. Craig Henderson, K.C., who appeared for the defendants, agreed. His Lordship granted an order embodying the terms of settlement.

The Wimbledon Affair.—At a meeting of the General Purposes Committee of the Wimbledon Corporation, communications received by the Mayor regarding the dismissal of Mr. F. T. Jenkins, who gave evidence on behalf of Mr. H. Tomlinson Lee in his recent slander action, were considered. It was stated that in 1914 the Council had conferred upon the borough electrical engineer sole control of the employés in the electricity department, and that the present electrical engineer, in the exercise of that power, had dismissed Mr. Jenkins, as well as another employé. The Committee decided not to pass any resolution on the matter. Moving the adoption of the Committee's report at the Council meeting, Ald. Bathgate said that, so far as he was aware, the men were dismissed because there was no work for them. The committee's minutes were approved by 16 votes to 7.

No appeal having been entered in respect of the slander action, the *Wimbledon Borough News* congratulates Mr. Tomlinson Lee on the jury's verdict—"A complete exoneration from the gross slanders which had been circulated against him and the charges recklessly and lavishly made in the course of the case." It says: "The Wimbledon Borough Council and its methods have been made a by-word, and the ridicule and contempt which they have provoked are reflected from the Council to the town which it represents. The episode is a shameful and a disastrous chapter in our municipal annals."

The Journal of Scientific Instruments.—The preliminary arrangements in connection with the regular publication of the *Journal of Scientific Instruments* have now been made by the Institute of Physics, in co-operation with the National Physical Laboratory. The special attention of those workers who have new designs for instruments is called to the fact that the *Journal* is to serve as a medium of publication of detailed descriptions and critical surveys of the behaviour of such instruments. Original papers or laboratory and workshop notes dealing with the practical or theoretical aspects of scientific instruments should be sent to the Editor, Dr. John S. Anderson, The National Physical Laboratory, Teddington, Middlesex.

The Ultramicrometer.—In a letter to *Nature* for June 2nd, Mr. John J. Dowling, of University College, Dublin, gives practical hints regarding the construction and use of his recording ultramicrometer, which was exhibited at the British Association meeting last year and briefly described in our pages at the time. It comprises a three-electrode valve connected to an oscillation circuit in which the condenser takes the form of two parallel metal disks, the distance between which can be adjusted by means of a fine micrometer screw. In the anode circuit is a sensitive galvanometer, the reading of which varies in correspondence with the capacity of the above-mentioned condenser, the relation being rectilinear within limits. Under suitable conditions described in the letter large deflections are obtained for minute displacements of the condenser plates, and infinitesimal movements of the latter can be measured.

Electrification and Electrocution.—In a recent issue of *Electrical Merchandising* a protest is made against the practice of American newspapers of giving prominence to the electrocution of criminals, and emphasising the deadly nature of electricity. It is thought that this entirely counteracts advertisements, perhaps on the same page, pointing out the safety of electrical appliances, and is undesirable *negative* publicity. The protest is made not merely against the publication of such details, but also against the whole practice of electrocution. The total abolition of this form of capital punishment is advocated, and the journal says that "one electrical man, now governor of Oklahoma, has officially refused to permit electrocutions in his State, and last month commuted the sentences of six criminals sentenced to die by electrocution."

A Novel Electric Sign.—CORRECTION.—In the note bearing the above heading in our issue of June 8th, we were incorrect in stating that the cables were supplied by the India Rubber, Gutta Percha and Telegraph Works Co., Ltd. The firm in question is the New Gutta Percha Co., Ltd., of Greenwich, whose "Pernax" insulation is employed in the cables.

China's Electrical Problems. — In a paper read at Shanghai in April, reported in the *China Press*, Mr. H. B. Pierce, of the International General Electric Co., reviewed the present position of electrical development in China. He excluded the Shanghai municipal electricity undertaking and the French power plant from the scope of his paper, stating that at present there were 205 recorded stations and up-to-date information was not available in respect of all of them. He found that there were 84 stations with capacities less than 100 kW; 81 were from 100 to 1,000 kW; and 41 were of greater capacity than 1,000 kW. Their total capacity was about 165,000 kW. (The Shanghai undertaking has about 120,000 kW of plant.) The plant installed came from various countries and chiefly on this account a great many different voltages and frequencies were met with. Thirty-two stations had 50-cycle machines, representing 81,750 kW; 54 were 60-cycle stations (65,090 kW); 25 generated d.c. (4,000 kW); two generated at non-standard frequencies (10,000 kW); and the systems of the remainder were not known. The problems of inadequate equipment and poor voltage regulation were very serious; in many cases a 20 per cent. variation was frequent, and in only six cases out of 25 were regulations better than 10 per cent. reported. The excessive voltage drop experienced in many systems caused a great deal of trouble, and steps should be taken to counteract this in the interests of the welfare of the industry.

Ships' Electrical Auxiliaries.—In a recent article in *Marine Engineering*, Mr. Walter Thau, general engineer of the Westinghouse Electric and Manufacturing Corporation, gave some remarkable figures, showing the economy of electrical auxiliaries on ships. He remarked that actual test data are available which show the fuel consumption of reciprocating steam winches to be more than twenty times that of electric winches supplied with power from Diesel-driven generators under practically identical conditions of handling. Other cases show the ratio to be in the order of 12 or 14 to 1.

Analyses indicate that in the case of an ordinary cargo ship there is a saving equivalent to between £3,000 and £5,000 by the use of electric winches, due to fuel economy alone, not to mention the economy in maintenance, the more expeditious handling of the cargo, and other very desirable advantages.

As the reliability of electrical auxiliaries on ships is sometimes questioned in this country by those who have no experience, Mr. Thau's comment that "it is doubted whether anyone would question the reliability of electrical apparatus for deck service," shows the general feeling on this subject in America.—*Motor Ship*.

INSTITUTION NOTES.

Illuminating Engineering Society.—The annual meeting of the Society took place on May 24th, Mr. A. P. Trotter presiding. The report of the Council contains a review of a considerable amount of work. The discussions during the past session have dealt with an exceptional variety of subjects, and opportunities have been taken for co-operation with kindred societies. It is proposed to form a small joint committee, on which educational authorities will be represented, to consider the framing of courses of instruction on illuminating engineering, and the preparation of a suitable textbook for students.

Following the presentation of the annual report an interesting paper was read by Dr. J. F. Crowley on "The Use of Synchronously Intermittent Light in Industry." It is well known that when moving machinery is illuminated by alternating-current arcs stroboscopic effects are apt to be produced; the effect becomes far more striking when one utilises a neon lamp, as in this case the light ceases instantaneously with the cessation of the current. Dr. Crowley showed how, by means of a disk with varied patterns, illuminated by a neon lamp operated by current in synchronism with the motion, to ascertain the speed by noting the particular pattern on the disk, which appears to be stationary. This is a familiar device. The use of an oscilloscope, comprising a neon lamp fed by alternating current from a small machine run from the moving machinery to be studied, has had other striking applications. The cyclical variation in the light can be varied within wide limits by adjusting the circuit, and the light is quite powerful enough to be used in practice. By adjusting the period of light fluctuation one can arrange that the moving machinery illuminated by the intermittent light appears stationary, or "crawls" at a very slow rate. Hence one can observe with the eye operations that would be completely invisible by steady light. A tachometer based on the frequency principle was also shown.

The oscilloscope has many useful applications, and in some factories where there is much quick-running machinery as many as twenty of these devices are in regular use. In the textile industry it is likely to prove of special value. In ordinary circumstances it is, of course, quite impossible to examine the actual movements of the machines. One only observes that on a particular machine the threads tend to break or become entangled and one can only make adjustments on the "hit or miss" principle until the defects disappear. But with the aid of the oscilloscope one can trace exactly the slowed-down motions, ascertain what happens when a breakage occurs, and make adjustments and see the process corrected.

Following Dr. Crowley's paper a demonstration was given by Mr. P. R. Ord of the Nutting-Hilger spectro-photometer, and its use for the comparison of natural and artificial daylight. A number of curves were thrown on the screen, showing how widely some so-called "artificial daylight" appliances depart from average daylight, and illustrating the value of accurate tests. By an extension of the apparatus allowance can be made for variations in the intensity of the natural daylight while an experiment is in progress.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.

Mr. John Varley having retired from the board of Callender's Cable & Construction Co., Ltd., Sir Malcolm Fraser, Bart., G.B.E., and Sir Ernest William Moir, Bart., a director of Messrs. S. Pearson & Son (contract department), Ltd., and other companies, have been elected directors.

According to a Scottish newspaper Mr. James Dalrymple, the general manager of Glasgow Corporation Tramways, has been invited to attend the annual convention of the American Electric Railway Association at Atlantic City in October next. At the same time he has been asked by the United States Steel Products Co., as its guest, to investigate personally the working conditions at its mills, in view of the criticisms which have been made against them. The company is a contractor to the Corporation for the supply of steel rails for the tramways department. These invitations have been before the Tramways Committee, which has recommended to the Corporation that Mr. Dalrymple should attend the convention only.

The Wimbledon Council last week adopted the committee's recommendation respecting the increase of the salary of the borough electrical engineer, Mr. A. E. McKenzie, from £1,000 to £1,250 this year, and to £1,500 next April if the net profits enabled the price of electricity for lighting to be reduced as stated in the Electrical Review, May 11th, p. 747. A number of amendments were defeated after discussion.

The salary of the tramway manager to the Edinburgh Corporation, Mr. R. Pilcher, is to be increased in three annual increments of £100 each by £300 per annum.

Mr. A. C. McColm, M.Inst.T., Parliamentary Assistant to the General Manager of the South African Railways, has been appointed Secretary to the South African Electricity Commission.

We are pleased to inform our readers that Mr. C. H. Wordingham, who was taken suddenly ill with an acute attack of gastritis at St. Stephen's Club, Westminster, last Saturday week, is progressing quite satisfactorily.

Mr. G. Leslie Dennis has resigned his position as charge engineer at the Gloucester Corporation electricity works to take up a similar post with the West Gloucestershire Power Co., at its new power station at Lydney. Upon leaving he was presented by Mr. F. H. Corson, on behalf of the staff, with a suit case and a silver pencil.

At a recent meeting of the directors of Messrs. W. Canning and Co., Ltd., two new members were appointed to the board, namely, Mr. A. Butcher and Mr. P. Brotherton. Mr. Butcher has been connected with the company for the last 25 years, and is responsible for the output of the company's well-known polishing materials. Mr. Brotherton passed from the sales managership of the engineering side of the business to represent the company outside, and has been one of Messrs. Canning's representatives for many years.

The board of Sir W. G. Armstrong, Whitworth & Co., Ltd., has appointed Lt.-Col. C. F. Hitchins, D.S.O., M.I.Mech.E., general manager of the Elswick Works, Newcastle-on-Tyne.

On June 2nd Mr. Hird, the general manager of Messrs. Siemens Brothers & Co., Ltd., presented Mr. R. H. Peet, in commemoration of his 50 years' service with the company, with a gold watch bearing the following inscription:—"Presented to Reginald H. Peet, Esq., by his colleagues as a mark of appreciation on completing his fiftieth year on the staff of Siemens Brothers & Co., Ltd. March, 1923." This token of friendship on the part of his colleagues was much appreciated by the recipient. The directors of the company supplemented the gift by a substantial cheque.

Mr. E. M. Munro has resumed his consulting practice at Finsbury Pavement House, London, E.C., in railless electric traction.

Mr. H. A. Trotter has rejoined the board of the Cordoba Light, Power and Traction Co., Ltd.

Mr. W. A. Ireland, switchboard attendant and relief shift engineer at the Rawtenstall Corporation electricity works, has been appointed junior engineer at the new Manchester power station at Barton.

The first chairman of Messrs. Evershed & Vignoles, Ltd., was the late Prof. W. E. Ayrton, F.R.S., who held the position till within a few months of his death in 1908. Since that date the chairmanship has remained vacant. Mr. SYDNEY EVERSHED, who recently retired from the position of managing director, has now accepted the office of chairman, and will in addition act as consultant to the company. Mr. E. B. Vignoles and Mr. A. Vines remain managing directors of the company.

Obituary.—MR. J. COLEMAN.—The death has taken place, at the age of 54 years, of Mr. Jesse Coleman, mains superintendent at the Hastings electricity works, where he had been engaged for upwards of 30 years.

NEW COMPANIES REGISTERED.

S. Mulliner, Ltd. (190,425).—Private company. Registered June 4th. Capital, £2,000 in £1 shares. To carry on the business of electricians, heating and ventilating contractors, electrical and mechanical engineers, &c. The subscribers (each with one share) are:—G. E. Pullen, 48, Ranelagh Road, Leytonstone, clerk; Miss C. W. Wormleighton, 9, Clement's Lane, Lombard Street, E.C.4. S. Mulliner signs as managing director. Registered office: 72, Harrow Road, W.

Lacy Patents Holding Co., Ltd. (190,413).—Private company. Registered June 4th. Capital, £1,000 in 1s. shares. To acquire from H. Lacy the benefit of the rights of, and to turn to account certain existing inventions relating to improvements in electro-magnets in the United Kingdom and Ireland and the Isle of Man, and to adopt an agreement with the said vendor and J. C. Snow. The life directors are:—H. Lacy, "Haycroft Hook," Surbiton; J. C. Snow, 18, The Grange, Wimbledon, S.W.19 (partner of W. H. Snow & Co.). Qualification of life directors, £100; of other directors, 50 shares. Remuneration as fixed by the company. Registered office: 48a, Gillingham Street, S.W.1.

Midgley Car Lighting Co., Ltd. (190,498).—Private company. Registered June 7th. Capital, £1,000 in £1 shares. To acquire any patent or other rights, and manufacture and deal in any inventions relating to improvements in electrical apparatus for lighting, starting, and ignition equipment or accessories for motor cars, cycles, boats, and the like, &c. The subscribers (each with one share) are:—H. J. Fellowes, 56, Rathcoole Gardens, Hornsey, N.8, solicitor's clerk; P. R. Isgar, 3, River Street, E.C.1, solicitor's clerk. The subscribers are to appoint the first directors. Remuneration as fixed by the company. Registered office: 12, Cockspur Street, S.W.1.

Cobb, Webb & Co., Ltd. (190,463).—Private company Registered June 6th. Capital, £3,000 in £1 shares (2,000 6 per cent. cumulative preference and 1,000 ordinary). To carry on the business of electrical engineers and contractors, suppliers of electricity, manufacturers of wireless apparatus, &c. The subscribers (each with one preference share) are:—Miss I. B. Soden, 129, Hopton Road, Streatham, S.W.16; F. Plummer, "Ryde Villa," Wroughton Road, Clapham, S.W.11, clerk. The first directors are not named. Solicitors: Waterhouse & Co., 10 and 12, Bishopsgate, E.C.

Fred Ellison & Co., Ltd. (190,492).—Private company. Registered June 7th. Capital, £1,500 in £1 shares. To carry on the business of electrical and mechanical engineers, textile and other machinists, manufacturers, merchants, and patentees of, and dealers in all kinds of metals and metallic wares, &c. The first directors are:—F. Ellison (permanent chairman and managing director), 31, Lower Rushton Road, Thornbury Bradford; W. H. Ellison, 31, Lower Rushton Road, Thornbury, Bradford. Qualification, £50. Registered office: 96, Harris Street, Bradford.

Electrical Ohms, Ltd. (12,719).—Private company. Registered in Edinburgh June 5th. Capital, £1,000 in £1 shares. To carry on the business of makers and sellers of all wireless instruments and accessories, manufacturers and factors of, and dealers in cycles, motors, tools, ironmongery, musical instruments, &c. The subscribers (each with one share) are:—H. T. Eagles, 644, Eglinton Street, Glasgow, merchant; J. Westerlen, 49, Watt Street, Glasgow, merchant. The first directors are not named. Qualification, 5 shares. Secretary: Simon Levine. Registered office: 7, Bridge Street, S.S. Glasgow.

Radio Reception, Ltd. (190,550).—Private company. Registered June 8th. Capital, £1,200 in 1,150 7½ per cent. cumulative preference shares of £1 each and 1,000 founders' shares of 1s. each. To carry on the business of radio, electrical, automobile, mechanical, and mining engineers, electricians, manufacturers of, and dealers in apparatus for transmission, emission or reception of sound, pictures, light, heat and power, also telegraphy, telephony, radio-telegraphy, and telephony, &c. The first directors are:—Capt. F. F. Trench (chairman), 6, Colville Houses, Kensington, W.11; H. L. Bing, 12, Dudley Road, Wimbledon, S.W.19. Qualification, £1. Registered office: 19, Bond Street, Ealing, W.5.

Elefactors, Ltd. (190,442).—Private company. Registered June 5th. Capital, £100 in £1 shares. To carry on the business of electricians, factors, suppliers and distributors of electricity and electrical energy for lighting, heating, telegraphic, telephonic, acoustic and wireless communications, traction (and motive power, mechanical, electrical, wireless, or other engineers, &c. The first directors are:—L. Waterhouse, 24, Maida Hill West, W. (director of Wilkinson Investment Trust, Ltd.); D. M. Milner, 30, Vanbrugh Hill, Blackheath, S.E. Qualification, one share. Remuneration, £25 each per annum. Secretary: K. E. Kamp. Solicitors: Milner and Bickford, 320, High Holborn, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lincolnshire Motor and Electric Traction Co., Ltd.—Third debenture dated May 16th, 1923, to secure £1,850, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: N. Green, Bargate, Grimsby.

Todman, Ryall & Co., Ltd.—Satisfaction to the extent of £250 on April 28th, 1923, of debentures dated May 10th and June 19th, 1922, securing £1,000.

Nox Electric Lamp Co., Ltd.—Debenture dated May 11th, 1923, to secure £982 13s. 4d., charged on the company's undertaking and property, present and future, including uncalled capital. Holders: W. Ellis, The Bungalow, Pudsey; and H. Wooldridge, 22, Mexborough Drive, Leeds.

Magnus Volk, Ltd.—Particulars filed of £5,000 debentures and £7,000 second debentures authorised May 23rd, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the amounts of the present issues being £4,200 and £1,000 respectively.

Bailton Magnetos, Ltd.—J. E. Jordan, of 79, Lichfield Street, Wolverhampton, was appointed receiver on May 18th, 1923, under powers contained in debentures dated February 18th, 1922.

Magnetic Transmission Co., Ltd.—Issue on May 31st, 1923, of £750 debentures, part of a series already registered.

Re-Echo Electrical Manufacturing Co., Ltd. (formerly the Re-Echo Wireless Manufacturing Co., Ltd.).—Mortgage debenture dated June 4th, 1923, to secure £1,200, charged on the company's assets, present and future, including uncalled capital. Holder: W. Taplen, 187, Holland Road, Willesden, Middlesex.

Winscombe Electric Light and Power Co., Ltd.—Satisfaction in full on January 1st, 1923, of debentures dated June 15th, 1914, July 17th, 1915, August 25th, 1919, and November 9th, 1921, securing £4,000. (Notice filed June 6th.)

James Keith and Blackman Co., Ltd.—Satisfaction in full on May 15th, 1923, of first debenture, dated May 15th, 1911, securing £4,000.

Issue on May 30th, 1923, of £1,050 debentures, part of a series already registered.

Radio Appliances, Ltd.—Satisfaction in full on April 9th, 1923, of debenture dated September 11th, 1922, securing £1,000.

Victoria Electrical (Manchester), Ltd.—Satisfaction to the extent of £3,785 8s. 5d. on June 30th of debentures dated January 28th, 1922, securing £5,500. (Notice filed June 2nd, 1923.)

United Kingdom Lighting Trust, Ltd.—A. N. Harper, of Austin Friars House, E.C., ceased to act as receiver or manager on May 11th, 1923.

W. H. Allen, Sons & Co., Ltd. (66,440).—Return dated May 21st, 1923. Capital, £500,000 in £1 shares. 408,750 shares taken up. £58,757 paid. £349,993 considered as paid. Mortgages and charges, £49,000.

Electric Sign Co., Ltd. (45,610).—Return dated March 6th, 1923. Capital, £5,000 in £1 shares. 2,000 shares taken up. £1,000 paid. £1,000 considered as paid. Mortgages and charges, nil.

Siemens Brothers Dynamo Works, Ltd. (88,928).—Return dated June 5th, 1923. Capital, £300,000 in £10 shares. 20,000 shares taken up. £70 paid. £199,930 considered as paid. Mortgages and charges, £200,000.

London Electric Warehouse Co., Ltd. (67,568).—Return dated December 31st, 1922 (filed March 16th, 1923). Capital, £1,000 in £10 shares. Eight shares taken up. £10 per share called up. £10 paid. £70 in arrears. Mortgages and charges, nil.

Chiswick Electricity Supply Corporation, Ltd. (38,854).—Return dated May 2nd, 1923. Capital, £100,000 in £1 shares. 62,800 shares taken up. £62,800 paid. Mortgages and charges, £73,000.

Jarrow and District Electric Traction Co., Ltd. (78,680).—Return dated April 12th, 1923. Capital, £60,000 in £1 shares. 59,934 shares taken up. £49,945 paid. £9,989 considered as paid. Mortgages and charges, £1,700.

Battiscome & Harris, Ltd.—J. M. Davies, A.C.A., of 18, Laurence Pountney Hill, E.C.4, was appointed receiver and manager on May 15th, 1923, under powers contained in instruments dated December 1st, 1922, and February 16th, 1923.

Lithanode Co., Ltd.—Issue on March 21st, 1923, of £1,650 debentures, part of a series already registered.

Central Electric Supply Co., Ltd.—Land Registry charge on certain land in Marylebone dated May 9th, 1923, to secure £300,000 and other moneys secured by trust deed dated June 22nd, 1921. Trustees: Merchants Trust, Ltd.

Wareham Electric Supply Co., Ltd.—Particulars filed of £5,000 debentures authorised May 16th, 1923, charged on the company's property, present and future, including uncalled capital, the whole amount being now issued.

CITY NOTES.

Electric Construction Co., Ltd.

Mr. P. E. Beachcroft presided at the annual meeting held on June 12th at the offices, Ingersoll House, 9, Kingsway, W.C.2. He said that the accounts showed a considerable reduction in net profit, but having regard to the conditions, the results were as satisfactory as could have been expected. The amount of work in progress at the beginning of the financial year was much less than usual, and although orders received showed a considerable improvement, the works were not employed to anything like their full capacity. The gross profit on manufacturing and contracting amounted to £108,108, and there was £16,251 from interest and dividends. The total expenditure amounted to £74,025. Income tax required £4,954 more. The abolition of excess profits duty automatically increased income tax. The net profit amounted to £50,333, plus £22,073 brought forward. The amount was to be distributed as set out in the report. At the last meeting he explained that a careful valuation by their own staff had been made of the company's buildings, plant and machinery, which proved that the value of these assets alone exceeded the amount standing in the balance sheet under the heading of "Properties, patents and goodwill." Accordingly, the last two items had been transferred to a separate account at the nominal value of £1. They were satisfied that the valuation was conservative, and the elimination of the items "Patents and goodwill" enabled a more reliable opinion to be formed of the value of the ordinary shares. During the year £9,130 of the first mortgage debenture stock was purchased and cancelled, the discount, amounting to £2,713, having been credited to the general reserve fund as usual. So long as they could procure the stock at about the present market price, it was advantageous to apply part of their surplus funds in that manner. A sinking fund was not provided by the trust deed, but nevertheless they considered it wise to reduce the amount outstanding under existing conditions. If the recommendation to transfer £17,287 to general reserve fund was adopted, the amount at the credit of the fund would

be raised to £160,000. This fund was invested in Government securities. They were holding their thirtieth annual meeting and had a good deal of pride in realising that they had played some part in the great development which had taken place in the electrical industry. Thirty years ago electric lighting existed only in the cities and larger towns, and electrical power was practically in the experimental stage. To-day electrical energy was rapidly superseding all other motive power, and the views which he had so often expressed at their annual meetings, that they had only touched the fringe of further great developments, were shared by authorities, one of whom recently expressed the opinion that "The Golden Age of Electricity" was not far distant. Transport problems in London had been practically solved by the use of electricity, and it was not unreasonable to forecast that in the near future they would see the general use of electrical energy for their trunk lines. The improvement in trade generally was still more sentimental than real, and even in the electrical industry the outlook was uncertain, but so long as the world's currencies were in a vortex, which threatened bankruptcy to some, reciprocity in trade could not prevail. Consequently, the export trade of this country was at present confined to its Dependencies, and this had the inevitable result of close competition and cutting of prices. He hoped and believed that with the vexed question of Germany's reparations settled, a real revival in trade would set in, but not before. The speaker acknowledged the valuable services of the staff and workpeople at Wolverhampton, and also of the head office staff, all of whom had co-operated in a manner which commanded the highest appreciation.

Mr. J. GRAY seconded the motion. In the course of a brief discussion, Ald. T. W. DICKINSON, as a resident of Wolverhampton, congratulated the company on its report, and also on having such an able manager as Mr. Furness. A shareholder referred to the statement as to a valuation having been made by the company's staff of the properties, and asked if they were competent to do this. The CHAIRMAN, in reply, said the staff knew the value of the plant better than anyone else, but the valuation was a pre-war one, and the value had since increased. They could take it from him that the figures stated were considerably below present-day value.

South Wales Electrical Power Distribution Co.

The report for 1922 shows that the figures in the accounts of the Treforest Electrical Consumers' Co. relating to the South Wales Co. were as follows: Total income, £223,343; working expenses, £196,239; leaving a balance of £27,104, to which was added £3,653 brought forward, making £30,757. This was allocated as follows: Interest on prior lien debenture stock, £15,527; interest on debenture stock, £14,521; carried forward, £709. It is stated that this unsatisfactory result was due to the breakdown in the company's station, caused by an excessive overload, which necessitated the running of a great deal of uneconomical plant. The new set was in course of erection but could not be completed in time to take up the load.

At the meeting proposals are to be put forward for the termination of the working agreements with the Treforest Electrical Consumers' Co., Ltd., which has altered its name to the South Wales Power Co., Ltd., and will be carried on in association with the company as a development concern. The administration of the South Wales E.P.D. Co. will be re-vested in the company itself. This is being done in order to facilitate the raising of fresh capital. Another 20,000-h.p. set has been ordered owing to the urgent necessity for providing plant to meet the increasing demand. To defray the cost of this, and to put the undertaking on a firm financial basis, an issue of £600,000 6 per cent. first mortgage debenture stock was recently made and considerably over-subscribed.

Anglo-Argentine Tramways Co., Ltd.

The directors' report for the year 1922 states that the gross receipts amounted to £4,529,978. Working expenses (including £150,402 carried to the renewals reserve) totalled £3,346,985, leaving a net income of £1,182,993. To this was added £6,032 brought forward, and interest on investments, &c., amounting to £10,675. The deductions were: Annuity to City of Buenos Ayres Tramways Co. (1904), Ltd., £70,660; debenture sinking fund and interest, £587,821; and sinking fund for redemption of preference and ordinary share capital, £7,890. It is proposed to deal with the balance of £533,329 as follows: Dividend of 5½ per cent. on the cumulative first preference shares for 1922, £176,000; dividend of 5½ per cent. on cumulative second preference shares in satisfaction of one year's arrears for the year 1918, £137,500; contingencies reserve, £175,000; writing-down value of investments, £32,000; leaving £12,829 to be carried forward.

The receipts from passenger traffic increased by 5¼ per cent., the number of passengers carried having risen from 439,133,491 to 469,512,046. The ratio of working expenses to receipts fell from 76.25 to 71.39 per cent. Owing to increased wages the traffic expenses were greater, but this was more than compensated for by lower traction expenses due to cheaper fuel. The renewals expenditure during the year was £120,737. The reduction in the net receipts was further adversely affected by the rate of exchange, which caused a loss of £86,082.

During the year the construction of the second subway in fulfilment of the company's 1909 concession came under consideration, after several years' postponement due to the European war. The company prepared and submitted to the Municipal Council plans for its early construction, with a proposal for a revision of fares to enable the company to raise the large amount of capital which would be required, and to continue to bear the increased burdens which were undertaken when the 12-cent fare was authorised in 1920 for a provisional period of three years, expiring on April 10th, 1923. When it became apparent that a decision could not be arrived at by the latter date the company asked for an extension for six months of the 12 per cent. fare, so that the position would not be prejudiced pending the consideration of the larger question. This extension was refused, and the directors consider that the Council's action was unreasonable. The result was that the 10-cent fare again came into operation, seriously affecting the company's revenue. The directors hope that this attitude of the Council will only be temporary and that the equities of the situation will ultimately be recognised. The scheme for satisfying the arrears of dividend on the second preference shares for the four years to December 31st, 1922, which was approved in December last, has been carried into effect without making any capital increase. The ordinary share capital, now reduced to £2,700,000, has been without dividend since 1913, and the continuance of the reduced tariffs will make the company's earnings insufficient to pay any future dividend on these shares, which are all held by the Compagnie Générale de Tramways de Buenos Ayres, of Brussels. The report mentions the death of Mr. W. F. Hamilton, K.C., and the appointment of Messrs. B. D. F. Docker and A. S. Jecks to the board.

The report of the general manager presents a rather hopeful view of the position of trade and industry in Buenos Ayres. The annual meeting is to be held at Winchester House on Tuesday next, June 19th.

United Electric Tramways of Montevideo, Ltd.

In their report for the year ended March 31st, 1923, the directors state that the operation of the tramway system for the year to October 31st, 1922 (the fiscal year of the Uruguayan Co.), shows gross receipts, at par of exchange (51d. to the dollar, or $4.7 to the £), of £567,125, being an increase of £11,400, but, against this, there has been a loss on exchange of £18,397. The operating expenses show a decrease of £4,391, due mainly to lower fuel costs. Remittances have again suffered from the low rate of exchange, which, unfortunately, has remained at a heavy discount throughout the year, the average value of the dollar being only 42d. The passengers carried were 68,691,962, being an increase of 932,574, although the number of car-miles run was 9,060,639, a decrease of 356,021 miles. Working expenses represented 74.32 per cent. of the receipts. The action against the municipality of Montevideo, arising out of its forcible and injurious intervention and seizure of the company's property during the first six months of 1922, is still pending. The directors are much disappointed to report again that the company has not been granted authority to increase its tariffs. More than a year has passed since the Chamber of Deputies approved an increase of the 4-cent fares to 5 cents, but it has not yet been confirmed by the Senate. The basis of an increase was agreed three years ago with a Special Committee appointed by the Uruguayan Government, and the urgent necessity for it is borne out by the accounts now submitted. After payment of debenture interest, and making the usual annual provisions for redemption of debenture stock and share capital, the remaining revenue is insufficient to meet the full preference dividend without again encroaching upon the balance brought forward. The profit and loss account, after providing for administration expenses, and charging £46,083 for debenture interest, shows a credit balance of £27,653, making, with £5,090 brought forward, £32,744. Out of this there has been put to redemption of debenture stock £6,417, and to redemption of preference and ordinary shares £2,500; the 6 per cent. preference dividend absorbs £22,500, and £1,327 remains to be carried forward. Owing to the burden of charges imposed by new social laws, and increased wages, and other expenses, there is little prospect of the earnings of the company being sufficient to provide a dividend on the ordinary shares while authority for the increase in tariffs, now long overdue, continues to be withheld.

West India and Panama Telegraph Co., Ltd.

Sir Alexander King presided at the annual meeting on June 6th. In presenting the report and accounts (*vide* ELEC. REV., June 1st, p. 867), he said that the only redeeming feature in the accounts was a reduction of £6,500 in the expenses, but this was more than counterbalanced by the reduction of £12,500 in the net traffic earnings. Since the beginning of this year the company had been able to increase its rates for messages between this country and the British West Indies, with the exceptions of Jamaica and Barbados, and this had resulted in receipts balancing expenditure in February and March. Unless the increased rates were permitted to stand after September 30th next, the company's service would have to cease. Sir Alexander deprecated the enormous expense which was being contemplated in connection with an "All-

Red" telegraph route. This would neither give additional security nor better service to the West Indies, with the possible exception of Demerara. The company now had duplicate cables from every island except Barbados, and this last disability was only as far as St. Vincent. The inhabitants of Barbados had transferred practically the whole of their telegraph business to an American company. Under the proposed cable system, the islands which were to have no cables at all would be much worse off than they were at present.

The report and accounts were adopted.

Delhi Electric Tramways and Lighting Co., Ltd.

The gross receipts for the year ended December, 1922, were: from the tramway undertaking £19,715, and from the electricity supply undertaking £58,318. The tramway receipts increased by approximately 20 per cent., and those from electricity supply approximately 12½ per cent. over the previous year. The combined undertakings show a net revenue of £30,783, as compared with £22,669 in 1921. The profit, after charging general expenditure in London and Delhi, debenture interest, and loss on exchange amounted to £24,967, plus £530 brought forward. There has been put to depreciation of plant and equipment £10,000, to reserve for British and Indian taxation £2,500, and to renewals reserve account £2,500, leaving £10,497, out of which the following dividends are recommended, less income tax: 8 per cent. per annum upon the preferred and participating shares and 1s. 6½d. per share upon the ordinary shares, leaving £292 to be carried forward. Additions to plant made during the year cost £20,119, and consisted mainly of new Diesel plant and rolling stock. The report refers to the death of Mr. T. W. Stratford-Andrews, a director of the company since its formation.

Spanish Companies.

The accounts of the *Electricas Reunidas de Zaragoza* for 1922 show a net profit of 1,245,477 pesetas; 7 per cent. has been paid on the shares; pension fund 10,000 pesetas; balance carried forward. During the year the management has been very actively engaged on modernising its plant and networks generally.

The report of the *Electrica Irurak-Bat, Sociedad Anonima* showed receipts 403,126 pesetas, expenditure 245,126, leaving a profit balance of 157,399 pesetas. After provision for the directors' fees and sinking fund, a net balance of 70,837 pesetas resulted, from which a dividend of 2 per cent. and a complementary dividend of the same amount were distributed, and after setting aside 10,000 pesetas State taxes, the balance of 9,497 was carried forward. Accounts are also given of the sundry new works completed or in hand—armoured standards for overhead lines, replacement of wooden by stone masonry structures for transformer posts, the building of a large transformer station equipped with machinery supplied by the Metropolitan-Vickers Electrical Co., Ltd., intended to distribute current supplied by the Sociedad Hidro-Electrica Iberica, of Bilbao. The machinery comprises two 500-kW, three-phase transformers, 30,000/5,500 volts, one being kept as reserve.

The report of the *Compañia Popular de Gas y Electricidad de Gijon* for 1922 referred, as the first and most important item, to the completion and equipment of the new station at Llano. The outlay on constructive works, machinery and lines involved had amounted to 516,409 pesetas. After the usual allocations, but none for bond redemption, a sum of 654,419 pesetas remained, which was divided as to 252,435 pesetas for machinery sinking fund, 41,985 State taxes, and 359,998 pesetas to the shareholders as a 6 per cent. dividend.

Italian Companies.

The *Società Elettrica del Mezzogiorno d'Italia*, of Cava dei Tirreni (capital 1,500,000 lire), has earned an available profit balance of 208,250 lire, which allows of a dividend of 7.5 per cent.

Notwithstanding that difficulties have occurred in the construction of the new great steam-generating station of the *Unione Tarantina Elettrogas Cacace e Ca.*, a balance for 1922 was registered of 103,614 lire, which allowed of the distribution of 4.5 per cent.

The *Società Elettrica Brindisina*, of Brindisi (capital 2,000,000), closed the year with a net available profit of 187,717 lire, which allowed of the division among the shareholders of a dividend of 1.8 per cent.

The *Società Distributrice Energia Elettrica Ing. Banfi*, of Arcore (capital 1,800,000 lire), finished the year's working to December 31st with a net profit of 1,107,847 lire.

French Companies.

The *Société Gramme* reports net profits of 534,000 fr. for 1922, and a dividend at the rate of 57.50 fr. per share.

The *Compagnie Générale des Cables de Lyon* reports net profits and balance forward amounting to 884,000 fr. in 1922, as contrasted with 1,357,000 fr. in the preceding year. The rate of dividend declines from 50 fr. per share in 1921 to 30 fr. last year.

The *Compagnie du Chemin de Fer Métropolitain*, of Paris, reports that the company's net share in the profits, including the balance forward, amounted to 12,586,000 fr. in 1922, as contrasted with 11,482,000 fr. in 1921. A rate of distribution of 30 fr. per share has been declared.

The *Forges et Ateliers de Constructions Electriques*, of Jeumont, after having made provision for depreciation, record net profits of 11,090,000 fr. for 1922, as compared with 11,057,000 fr. in the previous year. It is proposed to maintain the rate of dividend at 10 per cent. as in 1921.

The report of the *Compagnie Francaise Thomson-Houston* states that although 1922 was a difficult period for the whole of the industry, the company maintained a favourable situation. The new orders booked exhibited a large augmentation over 1921, and despite the increase in the productive capacity of the works, the orders still unexecuted at the end of 1922 were substantially equal to those in June, 1922. After having made provision for depreciation, the net profits are returned at 22,564,000 fr., as compared with 23,522,000 fr. in 1921, and a dividend at the rate of 9 per cent. has been declared, being the same rate as in the previous year. The report proceeds to refer to the orders received for railway electrification and telephone works, and to the continued efforts made in the various works to intensify the production, and to the developments which took place in connection with the many companies in which interests are held. At the recent annual meeting, the chairman stated that the specialisation of production at the various works was now almost completed, that the recent issue of new shares had been successful, and that the orders on hand on May 1st represented a value of 228,000,000 fr.

German Companies.

The *Electra Co.*, of Dresden, proposes to pay a dividend at the rate of 50 per cent. out of net profits of 23.75 millions of marks in 1922, comparing with 10 per cent. and 2.19 millions of marks in 1921.

The *Mix & Genest Telephone and Telegraph Works Co.*, of Berlin-Schöneberg, states that the works were well employed in 1922, and it was possible by means of an increase in the staff to augment the value of the turnover expressed in gold as compared with 1921, and also as contrasted with 1912 and 1913. The net profits were 70.91 millions of marks, as against 4.47 millions in 1921, and the dividend is advanced from 16 per cent. in the latter year to 150 per cent. in 1922.

The *Hartmann Braun Co.*, of Frankfort-on-Main, reports that despite all technical difficulties, it was possible to raise the quantity of the production in 1922 to the level of that which obtained in 1913, but the financial results did not keep equal pace. The net profits amounted to 219.57 millions of marks, as contrasted with 2.46 millions in 1921, and the directors propose to pay a rate of 300 per cent. (50 gold pfennig per share), as against 25 per cent. in 1921.

The *Accumulator Works Co.*, of Berlin and Hagen, states that business in 1922 was greatly prejudiced through the increased price of lead. During the first nine months of the year the works were well occupied, but reductions in working had to be made in the remaining months, and the influx of orders in the early part of 1923 continued on a lower scale. The substitution of sliding scale prices for the former fixed prices had led to great inconveniences, and in the case of a rising mark had not protected makers against losses. The directors propose to pay a dividend at the rate of 25 per cent. out of net profits of 13 millions of marks in 1922, this comparing with 25 per cent. and 6.76 millions of marks in 1921.

The *Felten & Guilleaume (Carlswerk) Co.*, of Cologne-Mulheim, reporting on the year 1922, states that the demand for the company's products, particularly in the iron and steel trade with other countries, was greater than could be satisfied. In lighting and power cables and in insulated conductors, the big depreciation in the mark which started in the middle of the year led to the exercise of great reserve on the part of consuming circles; the degree of activity in submarine cables improved. In general, working in 1922 proceeded quietly and without interruption; the turnover was less in quantity by 20 per cent. as compared with 1913, with an average number of persons employed of 7,024 and 6,326 in the two years respectively. The sale prices realised could be said in general to have been satisfactory, but the export business in cables and conductors yielded small profits owing to the burdens of the export tax, the turnover tax, &c. Out of net profits of 955.58 millions of marks (48 millions in 1921) a dividend has been declared at the rate of 400 per cent. or 80 gold pfennigs, as compared with 25 per cent. in 1921.

The *Bergmann Electricity Works Co.*, of Berlin, reports that all departments were well employed in 1922, although the situation became less satisfactory at the end of the year, and chiefly applied to production in bulk. The machine department had an abundant turnover, particularly that at Rosenthal. Orders were also brisk in the central station department, and a special bureau was established for the preparation of complete hydro-electric schemes. Although the formation of large groups between the coal and iron trades and the electrical industry had to a certain extent had an influence upon the company's transactions, the report states that it had still been possible for the industrial department to obtain extensive orders not only from the chemical, textile, sugar and paper industries, but also from the mining and ironworks industries. The traction department yielded good results; although German tramway business was small, it had been possible to obtain compensation through orders from abroad; contracts were also booked for newly developed high speed and heavy goods locomotives. Concerning the export trade, the report states that this had become more difficult owing to the loss of confidence in German industry, the difficulty of financing large installations, the necessity for holding large stocks abroad, &c. It was, however, hoped to be able to cope

with these matters through the further reorganisation of the export trade, which also extended to the Eastern market. The net profits in 1922 amounted to 391.85 millions of marks (20.07 millions in 1921), and the rate of dividend rises from 20 per cent. in 1921 to 200 per cent. last year.

Ruston & Hornsby, Ltd.—The directors report a net profit for the year ending March 31st of £12,043, after deducting £53,951 for depreciation and £25,500 for interest on debentures. Including the surplus brought forward, the balance is £70,274. It is proposed to carry this forward. The report states that the year was a very difficult one, and although there are signs of brighter trade prospects, the conditions are far from normal. To meet the possibility of further diminution in the values of stock-in-trade £50,000 has been transferred from general reserve. The directors feel that a conservative policy should still be pursued, and they are unable to recommend payment of the outstanding dividend on the preference shares or a dividend on the ordinary shares for the year.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 159 :—

Charing Cross, West End, and City Electricity Supply Co.—16,000 new ordinary shares of £5 each, issued at £7 10s. per share, partly paid and fully paid, Nos. 80,001 to 96,000.

Urban Electric Supply Co.—£250,000 5½ per cent. mortgage debenture stock, issued at 97½ per cent., partly paid and fully paid.

Yorkshire (West Riding) Electric Tramways Co.—204,885 ordinary shares of £1 each, fully paid, Nos. 350,001 to 554,885; and 231,305 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 231,305.

The undermentioned have been ordered to be officially quoted :—

Yorkshire (West Riding) Electric Tramways Co.—204,885 ordinary shares of £1 each, fully paid, Nos. 350,001 to 554,885; and 231,305 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 231,305.

New York Telephone Co.—Total operating revenue for 1922, $109,612,619. Operating expenses absorbed $95,738,797, leaving net telephone earnings $13,873,822, plus dividend and interest $11,109,157 and miscellaneous non-operating revenue $630,026, making $25,613,006. Interest absorbed $8,643,173, dividends on preferred stock $440,731, on common stock $16,375,360, leaving balance to surplus of $153,740.—*Financial Times.*

Sir W. G. Armstrong, Whitworth & Co., Ltd.—The directors in their report recommend that £771,516 be carried forward. Two interim dividends of 6d. each were paid, making 5 per cent. While there is an improvement in the general trade of the company there is keen competition and prices are very low. The hydro-electric and civil engineering departments have secured large orders, and these are also giving work to other departments.

Reduction of Capital.—*Associated Fire Alarms.*—A petition has been presented to the High Court for the reduction of the capital of the company from £160,000 to £60,000, and will be heard in London on June 19th.

Montreal Water and Power Co.—Special stock bonus of $25 per share on common stock from the accumulated surplus, payable in paid-up common stock.

Anderston Foundry Co., Ltd.—Final dividend of 15s. per share, less tax, making 18s. per share. £9,688 carried forward.

Manila Electric Corporation.—Dividend of 2 per cent. for the quarter ending June 30th on the common capital stock.

Cape Electric Tramways, Ltd.—Interim dividend of 3 per cent., free of tax.

Mackay Companies.—Quarterly dividend of 1¾ per cent. on common stock.

Globe Telegraph and Trust Co., Ltd.—Dividend of 5s. per share net, making 10 per cent. for the year, free of tax.

STOCKS AND SHARES.

TUESDAY EVENING.

FOREIGN politics overhang the Stock Exchange markets like a cloud, cutting off enterprise from investment as well as from speculation. There is plenty of money available—too much, from the point of view of national well-being, for capital comes into stocks and shares in default of finding profitable openings in trade and industry at home. Even America has to admit that " prosperity is off " in the States, although the problem of unemployment is much less acute there than it is at home.

Of the new issues, the Urban Electric 5½ per cent. debenture, offered at 97½, was rapidly taken, the lists closing very promptly. The Electric Supply Corporation 6 per cent. preference shares were left with underwriters to the tune of 82 per cent. The price started at 6d. discount, but soon hardened to nearly the par price of 20s., underwriters getting a profit in two or three days. Charing Cross new shares are quoted at a premium of 3¾ over the issue price of £7 10s. London Electric new, offered at 3, are 1¼ premium. In both these last-named cases, the old shares are quoted, of course, ex rights. The Urban scrip is 2¼ premium.

People still decline to look favourably at any of the Home Railway stocks, with the exception of the prior-charge securities. Consequently the ordinary prices quietly crumble. Underground £10 shares drifted back to 3. Metropolitans are steady at 73½, but Districts lost a point at 55. Arrangement of the carry-over this week showed that there is something of a bull account in both these stocks. Last year, Districts paid 3 per cent. and Metropolitan 3½ per cent. For the current twelve months, the present dividend estimates are 4 per cent. and 4½ per cent. respectively. London and Suburban preference are sixpence down at half-a-guinea, upon disappointment with the falling-off in the traffic receipts. Other British Traction issues keep their prices fairly well without attracting much attention. Potteries Traction ordinary are lower at 6s. 3d. London General Omnibus 4½ per cent. first debenture is better at 94½.

Holders of Castner Kellner shares—of which 9,000 shares remain out of the million that there were in 1920, when Brunner Monds acquired control—are offered £4 per share by the directors, one of whom signs the circular making the bid. Brunner Monds gave two of their own shares for one Castner Kellner, and as Brunner's stand about £2, the offer of £4 is a fair one; probably the majority of Castner proprietors will be pleased to accept the present price. Their consent must go in by the Friday in this week.

City of London ordinary shares have risen to 2½, and St. James's at 11½ are 7s. 6d. higher. Westminsters improved to 9½. The slight improvement in weather conditions with which June has favoured us has come too late, and too capriciously, to prevent the electricity supply companies from making exceptionally good profits owing to the chilliness and dulness of what are called, by courtesy, Spring and Summer. Maintenance of the dividends at last year's rate can almost be regarded as assured, and, however heartily the weather may be cursed by those whom it has deprived of their outdoor sport, the shareholder in electricity supply companies will have nothing but kindly thoughts about it. Changes in the telegraph and telephone list are rare. A fall of £1 in Indo-European has reduced the price to 30½. Anglo-American Telegraph stocks are better. The only alteration in the Eastern group is a decline of ¼ in Globe Telegraph and Trust ordinary shares. Marconis are inanimate, remaining at 2 5/16 almost without a movement, since a week ago.

Mexican Light and Power Common shares are 2 dollars up, the preferred 1, but Mexico Tramway Sixes eased off to 61½. Brazilian Tractions improved a couple of dollars, on a slight rally in exchange. British Columbia stocks are again better. Anglo-Argentines are steady, the report making no difference to the prices.

It may be convenient at this stage to interpellate an explanation regarding the source from which our quotations are drawn. The figures given are the middle prices printed every Tuesday night in the Stock Exchange Daily Official List. Some of these are very wide, *e.g.*, Central London Assented ordinary is officially quoted at 72 to 76, and the reason given for what to many of us appears an unduly wide margin between selling and buying prices is that there is so little business doing in the stocks as to make dealing in them a matter more of negotiation than of facile sale and purchase. Wide prices may be at times misleading : that is an indisputable fact. Yet in making-up such lists as those given here, it is necessary to act upon some regular plan. In case of dispute or question, reference to the price being that which is officially quoted by the Stock Exchange affords the clearest answer to what inquiry may from time to time arise from those who feel dissatisfied at a market price, fluctuating it may be from hour to hour, being slightly different from the middle figure of the two levels quoted in the Stock Exchange Official List.

Edisons have risen 9d. to 4s. 6d., and the preference are harder at 17s. 6d. A private meeting of some of the large shareholders was held the other day, and a plan suggested for dealing with the share capital in such a way as might put the finances upon a better basis. This cheered the minds of those who have been fearing, for some time past, a possible reorganisation that would involve provision of more money by holders of the ordinary shares. Nothing official has been announced up to Tuesday evening, and the various suggestions made at the meeting are, of course, quite informal.

British Insulated ordinary have lost 1/16, bringing the price, 2 7/16, into line with Callender's and Henley's. English Electrics are a good market at 18s. 9d. Electric Constructions advanced to 30s. Babcock & Wilcox new shares are quoted, for the first time. Nominally, the new are about 6d. lower than the old, but the difference is bound to be adjusted as it becomes recognised that the two classes, old and new, rank alike for dividend payments. Rubber shares present few points of interest; iron, armament and steel issues move within narrow and rather aimless bounds.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price June 12. 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	36/6	—	£6 11 4
Charing Cross Ordinary	5	9	14	11½xr	—	6 1 9
do. do. do. 4½ Pref.	5	4½	4½	4⅞	—	5 2 10
Chelsea	1	6	10	1⅞	—	5 14 3
City of London	1	14	15	2½	+ 1/16	6 0 0
do. do. 6 % Pref.	1	6	6	23/-	—	5 4 4
County of London	1	8	10	38/9	—	5 3 3
do. do. 6 % Pref.	1	6	6	23/-	—	5 4 4
Edmundson's Ordinary	3	Nil	—	2⅛	+ ⅛	Nil
do. 6 % Pref.	5	12/-	—	4¼	—	6 8 0
Kensington Ordinary	5	10	12	9½	+ ½	6 6 4
London Electric	3	4	10	4½xr	—	6 12 9
do. do. 6 % Pref.	5	6	6	5⅜	+ ¼	5 11 7
Metropolitan	1	7	8½	29/-	—	5 17 4
do. 4½ % Pref.	1	4½	4½	18/-	—	5 0 0
Newcastle-on-Tyne Ordinary	1	Nil	2½	7/8	—	2 17 2
do. 5 % Pref.	1	5	5	16/3	—	6 3 1
do. 7 % Pref.	1	7	7	24/6	—	5 14 2
Notting Hill, 6 per cent. Pref.	10	6	6	9½	—	6 9 9
North Met. Elec., 6 % Pref.	1	6	6	1⅛	—	5 13 0
Urban Ordinary	3	Nil	—	1⅜	—	Nil
do. 5 % Pref.	5	2½	—	4½	—	5 11 1
St. James' and Pall Mall	5	12	14½	11⅝	+ ⅜	6 2 1
South London	1	7	10	1⅜	—	5 14 3
South Metropolitan Pref.	1	7	7	1½	—	5 12 0
Westminster Ordinary	5	10	12	9¼	+ ¼	6 1 6
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	20/-	—	7 10 0

HOME RAILS.

Central London Ord. Assented	Stock	4	4	7¼	—	5 8 1
Metropolitan	,,	2½	3½	73½	—	4 15 3
do. District	,,	1	3	55	−1	5 9 2
Underground Electric Ordinary	10	Nil	Nil	3	— ¼	Nil
do. do. "A"	1	Nil	Nil	8/6	—	Nil
do. do. Income	Stock	4	5	97	—	*5 3 1

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	106	+1	5 13 3
do. Def.	,,	1½	84/6	20½	+ ½	6 9 0
Chile Telephone	5	6	6	6¾	—	4 18 0
Cuba Sub. Ord.	10	7	7	7½	—	9 6 8
Eastern Extension	10	10	10	18⅝	—	5 6 8
Eastern Tel. Ord.	Stock	10	10	187½	—	5 6 8
Globe Tel. and T. Ord.	10	10	10	18⅝	— ¼	5 6 0
do. do. Pref.	10	6	6	11⅞	—	5 2 2
Great Northern Tel.	10	21	22	28½	—	7 5 6
Indo-European	25	10	7	80½	−1	5 14 9
Marconi	1	25	15	2 7/16	—	6 9 10
Oriental Telephone Ord.	1	12	12	2⅝	—	*4 3 6
United R. Plate Tel.	5	8	8	7½	—	*5 10 4
West India and Panama	10	Nil	Nil	1/6	—	Nil
Western Telegraph	10	10	10	18½	—	*5 6 8

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams. First Pref.	5	5½	12½	8 3/16	—	8 6 0
do. do. 2nd Pref.	5	Nil	5½	3	+	9 3 4
do. do. 5 % Deb.	Stock	5	5	79½	—	6 5 9
British Electric Traction Ord.	,,	4½	5	77½	−1	6 9 0
do. do. 6 % Pref.	,,	6	6	100	—	6 0 0
Brazil Tractions	100	Nil	4	53	+2	7 11 0
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	89½	—	5 11 9
do. do. Preferred	,,	5	93/-	81½	+2	*5 15 9
do. do. Deferred		3	124/-	91½	+2	*6 15 0
do. do. Deb.	,,	4½	4½	81	—	5 5 0
Lond. & Sub. Trac. 5 % Pref.	1	3½	5	10/6	— 6d.	9 10 6
London United Tram. Deb.	Stock	4	4	65½	—	6 2 2
Mexico Tram. 5 % Bonds	—	Nil	Nil	85½	—	5 17 0
do. 6 % Bonds	—	Nil	Nil	61½	−1	Nil
Mexican Light Common	100	Nil	Nil	39½	+2	Nil
do. Pref.	100	Nil	Nil	62½	+1	Nil
do. 1st Bonds	—	Nil	5	75½	—	6 12 5

MANUFACTURING COMPANIES

Babcock & Wilcox	1	15	20	21	—	4 9 1
British Aluminium Ord.	1	10	5	20/9	—	4 16 5
British Insulated Ord.	1	15	15	3 1/16	— 1/16	6 3 0
Callenders	1	15	15	2 7/16	—	6 3 0
do. 6% Pref.	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	10	5	8	—	3 0 0
Edison-Swan	1	10	Nil	4/6	+9d.	Nil
do. do. 5 % Deb.	Stock	5	5	67	—	7 9 3
Electric Construction	1	10	10	1⅜	+6d.	6 13 4
English Electric	1	8	5	18/9	+ 1/16	5 6 8
do. do. Pref.	1	6	6	20/6	—	5 17 1
Gen. Elec. Pref.	1	6½	6½	24/6	—	5 6 1
do. Ord.	1	10	5	20/9	+2d.	4 16 5
Henley	1	15	15	2 3/16	—	6 3 0
do. 4½ Pref.	5	4½	4½	4½	—	5 0 0
India-Rubber	1	10	—	½	—	—
Metrop.-Vickers Pref.	9	8	8	9½	—	6 8 0
Siemens Ord.	1	10	10	17/-	—	Nil
Telegraph Con.	12	20	20	25½	—	*4 16 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS FOR CHEMICALS AND METALS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances

CHEMICALS, &c.	Price June 13th.	Fortnight's Inc. or dec.
a Acid, Oxalic per lb.	6½d.	...
a Ammoniac, Sal per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£32	...
a Bisulphide of Carbon ,,	...	...
a Borax ,,	£28	...
a Copper Sulphate ,,	£26 15s.	...
a Potash, Chlorate per lb.	4d. to 4½d.	...
a ,, Perchlorate ,,	5d.	...
a Shellac per cwt.	£15 10s.	...
a Sulphur, Sublimed Flowers ,,	£9	...
a ,, Roll ,,	£8 10s.	...
a Soda, Chlorate per lb.	3d.	...
a ,, Crystals per ton	£5 10s.	...
a Sodium Bichromate, casks per lb.	4½d.	...
METALS, &c.		
b Aluminium, Ingots per ton	£115 to £120	...
b ,, Wire ,, per lb.	1/9 to 2/6	...
b ,, Sheet ,, ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		...
Grade I per ton net	£182	...
Grade II ,, ,,	£180	...
Grade III ,, ,,	£73	...
c Brass (rolled metal 2" to 12" basis) per lb.	10½d.	...
c ,, Tubes (solid drawn) ,,	1/0½ to 1/0½	...
c ,, Wire, basis ,,	10½d.	...
c Copper Tubes (solid drawn) ,,	1/2d.	...
c ,, Bars (best selected) per ton	£100	...
c ,, Sheet ,,	£100	...
c ,, Rod ,,	£100	...
d ,, (Electrolytic) Bars ,,	£74 10s.	...
d ,, ,, Sheets ,,	£145 10s.	...
d ,, ,, Wire Rods ,,	£84 10s.	...
d ,, ,, H.C. Wire per lb.	10½d.	...
f Ebonite Rod ,,	3/6	...
f ,, Sheet ,,	3/-	...
n German Silver Wire ,,	2/3	...
h Gutta-percha, fine ,,	6/6	...
h India-rubber, Para fine ,,	1/2½	½d. inc.
i Iron Pig (Cleveland Warrants) per ton	92s. 6d.	...
i ,, Wire, galv. No. 8, P.O. qual. ,,	£25	...
g Lead, English Pig ,,	£27 5s.	5s. inc.
g Mercury per bot.	£10 to £10 7s. 6d.	7/6 to 10/- dec.
e Mica (in original cases) small per lb.	3d. to3/-	...
e ,, ,, medium ,,	4/- to 8/-	...
e ,, ,, large ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/2	...
p ,, drawn bars and rods ,,	1/4	...
p ,, rolled strip & sheet ,,	1/3½	...
p ,, wire ,,	1/4	½d. dec.
o Platinum per oz.	£23	...
d Silicium Bronze Wire per lb.	1/1½	...
r Steel, Magnet, in bars ,,	10d.	...
n Tin, Block (English) per ton	£198 10s. to £197	20/- dec.
n ,, Wire, Nos. 1 to 16 per lb.	3/-	...

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Automatic Generating Stations. — According to the *Electrical World* there are now in operation in California 15 automatic or semi-automatic generating stations, having an aggregate output of 20,000 kW. These stations would not have been economically practicable with manual operation. It is now possible to duplicate every operation of manual control, and to observe the operating conditions of an automatic station at a distant point, and a system of supervisory control has been worked out by means of which, over a single pair of wires, it is possible to "listen in" on a distant station and determine the position of circuit-breakers, water level, load on the station, hot bearings, &c. The present tendency in design is toward the use of induction generators, though most of the stations in operation are equipped with synchronous machines. The economic size limit is placed at 5,000 kW at present. Amongst the stations at work are three using heads of 750/1,150 ft. Nine semi-automatic installations are working on the system of the Southern California Edison Co.—one man being on the premises as watchman and caretaker, who can start the plant in the event of a shut-down.

Irish Water-power Resources.—In the Irish Free State Parliament (Senate), Colonel M. Moore moved a resolution requesting the Government to establish a Board of Control to provide for the development of water power and navigation, and the establishment of a hydrometric system of survey. Col. Moore stated that if private individuals obtained possession of the water power it might be difficult to buy them out, and, as to cost, he thought it would be better to begin in a small way. The total cost of a hydrometric survey he estimated at about £7,000 per annum. Ultimately, the resolution was altered to read as a request to the Government to establish unity of control and also to institute a hydrometric survey, and in this form it was passed.

EXPORT ORGANISATION.

Advice to the Smaller Manufacturer.

By LEON GORINI.

So much has been written at various times on this subject that, at first sight, it would appear superfluous—even audacious—to attempt making suggestions or giving advice on this matter; it is difficult to avoid repetition and perhaps seeming plagiarism.

The importance of the question, however, especially at the present time, and the fact that apparently so little notice has been taken of previous similar articles, as well as the alterations that have taken place in conditions, may be sufficient excuse for the present article.

This contribution is primarily intended for smaller manufacturers who cannot afford to have a complete and distinct export organisation with their own foreign branches such as their more prosperous competitors can have; at the same time, some of the hints given may prove useful to others.

The small exporter will, of necessity, have to work through the agency of a number of independent representatives in the various countries; but as he cannot afford, on account of his limited variety of goods, to appoint a suitable man to look solely after his interests, he will have to depend on a representative simultaneously working various agencies, the nature of which will not always be known to him. As it is only natural that the man will give his best attention to his most profitable line of goods, it is apparent that success will only be partial. The best course, therefore, in these circumstances, is for a number of small manufacturers at home, who can place full trust in each other, to join hands for the purpose of facilitating their export business and to reduce their working expenses. Such a combination would possess most of the advantages of the distinct export organisations of the larger concerns and would be in a position to appoint a well-established representative for its exclusive interests.

This leads us to consider the export organisation in its two component parts, the home and the outside organisations, both of which must work in unison to make the enterprise successful, as neither alone can possibly expect, however well organised it is individually, a lasting and gradually improving business. This is so natural that the mere mention of it appears at first sight almost ludicrous; however, when the two sections have been more or less independent of each other, as they are bound to be in such cases, the absence of co-ordination, which originates from misunderstanding and lack of trust, has been the cause of repeated failures. This disadvantage is excluded from the big organisation, as the home office always remains in absolute control of the foreign branch. It is therefore of primary importance to study the ways and means by which the necessary co-ordination can be achieved.

Reverting to the home organisation, the matter that calls for first consideration is the setting up of the combine on a sound basis. The ideal arrangement, of course, will be obtained if the goods of its various members are not similar; this condition may, however, not be fulfilled easily, as even small manufacturers to-day do not and cannot restrict themselves to one line of articles; but, with goodwill, this difficulty can well be overcome and need not be a stumbling block to preliminary parleys.

The principal aim of the combination is to get together as complete a line as possible of such articles as are required in conjunction with one another, so that the sale of one will call for the sale of another; for this reason it will be better to have two similar articles for disposal than not to have this class represented at all or only inadequately, and the choice should be left to the prospective buyer.

Such a combine should include, as principal and leading members, makers of a.c. and d.c. machines and of transformers up to about 400/500 kW; although these firms may also supply switchgear in connection with their machines, it will be necessary to obtain the co-operation of switch- and control-gear manufacturers who are in a position to offer a complete line of apparatus for the more general applications. Supply articles, such as small fans, cooking and heating apparatus, and fittings, can be obtained as a complement either by direct co-operation of a further member or by factoring them under favourable conditions. The combination can still be enlarged and strengthened by the inclusion of makers of small oil and steam engines, pumps, &c.

The new organisation must for obvious reasons be kept away from the direct influences of any of the co-operating firms, and must be absolutely independent of them in the management and in the working-out of the most favourable policy; otherwise mistrust, created by the belief of unjust preference, will creep in and cripple the best efforts. It will, of course, always remain under the joint control of the co-operators, but uninfluenced by any one singly.

The first work of this central body will be to collect the necessary information from the various works and arrange it in a suitable form for export use, and issue a well and carefully-planned catalogue. A few words on this important, yet neglected and misunderstood subject, will not be out of place: One must first clearly realise the purpose of a catalogue; it is not intended to be either a charlatan's advance agent broadcasting his history or a student's text-book demonstrating to him in the minutest details the construction of the article in question. A catalogue is primarily intended for an engineer's use, and should therefore be compiled by an engineer with the idea of imparting to the prospective user the information he requires, and only that information without superfluous details to distract his attention. We are speaking now of the "bread-and-butter" line—small machines, auxiliary gear, &c. A concise description of the article, explaining in a few words its object and its performance, followed by a clear table giving guarantees, prices, and weights, will allow the estimating engineer or the client to find at a glance the information required; with the exception of special cases, the knowledge of the material used for the various screws and bolts of the machine is of no interest.

Such lists, of course, as has repeatedly been emphasised by foreign correspondents and official representatives abroad, must be in the language of the country and contain all information in the system in vogue. At the present time it may be difficult to quote prices in the various currencies, although the same object can be obtained in an indirect way. For this purpose the prices must be given in shillings only, as this unit bears a direct relation to the currency of most countries. As it is usual to allow a discount on catalogue prices, this could be given in the form of a factor which would take into account the exchange value, at the time, of the currency of the country concerned; this factor would be altered, independently of variations in the costs of production, from time to time according to the fluctuations in the exchange, or it could be fixed in advance for various limits of values of the respective currencies. The following example may further explain the arrangement: The list price of a machine is £95 12s., on which a discount of 25 per cent. is allowed; the net selling price is therefore £71 14s. The price would be

given in the catalogue as 1,912 shillings. Assuming that the catalogue was intended for use in France, and that the exchange was 70 fr. to the pound sterling, the factor would be 2.63, as 2.63×1,912 sh.=5,028.55 fr.= £71 16s. 8d.

So long as the discount does not alter, the factor would vary in direct proportion with the exchange.

This scheme enables a client in any country to obtain the price in his own currency by a simple multiplication; it has the further advantage of eliminating separate calculations of prices for every country in which the catalogue will be used.

With regard to the fixing of export prices, a very important factor, especially under the present conditions, which is not always fully appreciated by smaller firms, is the packing; yet this plays a threefold part in the increase of the selling price. It appears first as its own cost, again in the cost of the freight, and, to a still greater extent, in the form of import duty. The packing should therefore not be left in the hands of labourers, but should be designed, just as a machine is designed by an engineer, by an experienced packer with the object of saving weight and space, and yet securing safe transport.

The question of credit, principally in countries outside the Empire, must be given due consideration and discussed with the representatives concerned according to the customs. As a rule, it will be difficult to obtain payment against shipping documents, and two to three months' credit will have to be reckoned with; the corresponding loss of interest must, of course, be taken into consideration in fixing the selling prices. An increasing turnover might, however, on account of the large sums involved by these credits, cause the small exporter real financial difficulties. For this reason a substantial inducement for cash payment on receipt of goods should be offered in the form of a special discount; in other cases it may be possible to obtain a promissory note, on which the manufacturer could get the credit needed.

Reverting to the outside organisation, the representative should preferably be a native or at least have lived and been engaged in similar work in the country for some length of time, so that he may be familiar with the customs of the people. The search after the most suitable man will be facilitated by the advice of consular agents, but in the first instance the exporter must have recourse to advertisements and a reliable information bureau.

It is not sufficient for the representative to be a good organiser and a smart salesman with bank and other references; he must be a capable all-round engineer; only if he has this latter qualification will he be able to compare competitive goods, advise his principals as to the suitability of their design, suggest the necessary modifications to meet various requirements, and, above all, give his principals information in a useful and comprehensive form. It is, for instance, superfluous for an outside representative to report to headquarters the loss of an order on account of high prices; this conclusion would naturally, after a certain time, have been drawn at home without his comments. The interest of a lost order centres not in the knowledge of the loss, but in the cause of the higher price, and to enable the manufacturer to ascertain this, the report must contain information on the performance, weight, and finish of the preferred article. Such particulars carefully filed and studied will form the basis for future improvements and alterations, and enable the estimating engineer to prepare on future occasions the most suitable offers.

As the representative cannot be expected to become fully acquainted with all the details of the various goods he is to sell and with the secrets of their manufacture, the combine should train one of its men in the various works and lend him at its cost as technical adviser to the appointed representative. The information that this man will be in a position to collect and pass to his employers will, in a short time, prove a real and profitable return for the money expended.

We have considered at some length the importance of the catalogue and the object it has to fulfil; it remains now to study how to corroborate and strengthen the good impression it has made, and this can best be done by an attractive display of the principal goods, from the inspection of which a client will gain the assurance of the manufacturers' reliability. This will not increase the working expenses to a great extent, as the showroom can well be combined with the stock, which in any case is necessary.

The author wishes to warn the prospective exporter against taking half measures; it would be more than useless, nay, it would mean a certain loss, to try to do export business as a hobby or as a kind of side line to his home trade. He must well consider before engaging in foreign trade enterprise the costs and the possible returns from it and then throw himself heart and soul into it, thus definitely giving the representative the assurance of a certain and continued support; only then will he achieve the hoped-for success.

A NEW RADIO-TELEPHONE RECEIVER.

A Combined Kenotron and Pliotron Capable of Operating on Alternating Current.

The combination of a kenotron rectifier (for supplying the plate voltage) and an equipotential cathode pliotron (that can be heated by an alternating current without producing an appreciable a.c. hum in the output circuit) in a single 4-element tube is a new development that has interesting characteristics.

The principle, as described by Mr. A. W. Hull, of the American General Electric Co., in the *Proceedings* of the Institute of Radio Engineers, from which the following details and illustrations are abstracted, is clearly shown in fig. 1, which represents a two-tube a.c. receiver, the kenotron rectifier furnishing the plate voltage for the pliotron detector; the pliotron cathode-heating battery is omitted, the cathode being connected directly to the anode of the kenotron, and it is evident that the device will function equally well if the two elements are combined so that the kenotron anode can also be used as the pliotron cathode, the resulting circuit being shown in fig. 2.

The structural features of one form of such a double-function value are indicated in fig. 3. The filament is a helix of tungsten wire, maintained at a temperature of approximately 2,300 deg. K. by 2 A at 5 V. a.c. The cathode is a nickel cylinder ¼ in. in diameter by 1¼ in. long coated with barium oxide, and the grid and plate are concentric cylinders surrounding the cathode, the grid being a helix 1 in. long by ¼ in. in diameter, consisting of 40 turns of 3-mil (0.008-cm.) molybdenum wire. Fig. 4 is a cross-sectional view of a valve suitable for operation from a lamp socket, without transformers; the filament is a standard tungsten helix, such as is used in gasfilled lamps, and the cathode a nickel cylinder ¼ in. in diameter and 1¼ in. long.

In the typical receiving circuit (fig. 5) incorporating a single valve of the type shown in fig. 3 the filament voltage is obtained from a step-down transformer; one side of the 110-V, a.c., power line is connected to the filament and the other to the plate so that the filament swings plus or minus 110 V with respect to the plate terminal. On the negative side it feeds current to the cathode which is stored by the condenser c_1, and further smoothed by the condenser c_2 and the resistance r. A single valve with a 110-V filament is represented as a detector in fig. 6; it utilises the a.c. power line as an antenna and the only accessories needed are the telephones, filter, and tuning unit.

In order that rectification may result when a single valve is used as a half-wave rectifier (figs. 2 and 5), the outside surface of the cathode is made to have a higher electron emissivity than the inside by coating it with an oxide; the necessity for unilateral electron emissivity is removed when full-wave rectification is employed, but if a single valve with a 110-V filament be used as a full-wave rectifier (fig. 4) the

electron emission from the inside of the cathode may be the same as that from the outside, provided it is less than that of the filament; for, in this case, the cathode is always receiving electrons from one end of the filament at the same time as it is emitting them to the other end, and it is only necessary that the number received should be in excess.

A resistance-capacity filter gives satisfaction, and is lighter and cheaper than the usual inductance-capacity type; that shown in fig. 6 consists of three 2-microfarad condensers and two 4,000-ohm resistances, and is capable of furnishing five milliamperes at 60 V, with half-wave rectification. An earth connection is, generally, not necessary, the a.c. line being

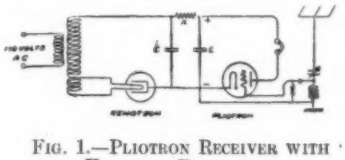


FIG. 1.—PLIOTRON RECEIVER WITH KENOTRON RECTIFIER.

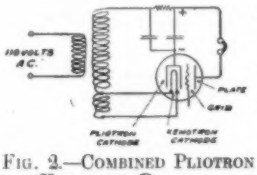


FIG. 2.—COMBINED PLIOTRON KENOTRON RECEIVER.

sufficiently earthed; earthing the circuit at any point does no harm, but may interfere with operation or introduce an a.c. hum; it is preferable to make the earth connection through a condenser as shown in fig. 5.

The volt-ampere characteristics of a new valve similar to that illustrated in fig. 3 are compared in figs. 7 and 8, with those of a standard UV-201 amplifier valve at the same plate voltage, the former being much steeper, as is also the grid current characteristic, so that a higher detection coefficient may be expected. The values of mutual conductance, plate resistance, and amplification constant for the new valve are 1.5×10^{-3}, 18,000, and 27 respectively, as compared with 0.28, 20,000, and 6 for the UV-201 type of valve. The operating characteristics of the new valve are identical with those of standard pliotrons, but its voltage amplification is about four times that of the UV-201 type, at both radio and audio frequencies, which fact is specially significant in the case of

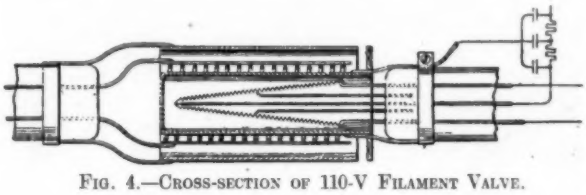


FIG. 4.—CROSS-SECTION OF 110-V FILAMENT VALVE.

radio frequency; at 300 metres a resistance-coupled UV-201 type amplifier gives a voltage amplification of 2 per valve, whereas the equipotential cathode valve averages 7-fold voltage amplification—a single valve of the latter type being thus nearly the equivalent of three of the former pattern.

Under normal conditions a.c. hum cannot be heard when a single valve is used; with two in series, the hum can be heard only when the telephones are pressed tightly on the head, but with three in series hum is quite noticeable, although not objectionable; a large part of the hum is probably due to circuit induction and can be eliminated by shielding.

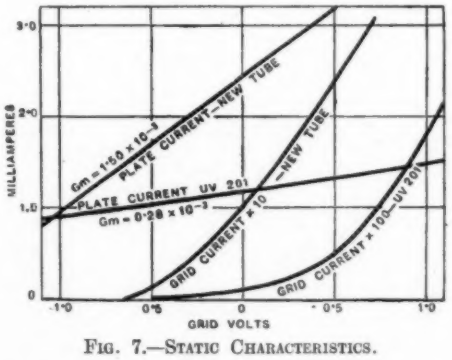


FIG. 7.—STATIC CHARACTERISTICS.

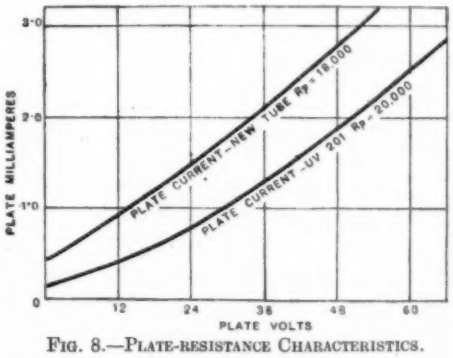


FIG. 8.—PLATE-RESISTANCE CHARACTERISTICS.

An important operating feature of this type of receiving equipment is its safety; nothing that the operator can do can harm either himself, the receiving tube, or the lighting circuit. The a.c. power terminals are made inaccessible by the use of standard lamp receptacles and plugs, all exposed terminals are protected by high resistances, and no injury can be done to the valve by short-circuiting either the pliotron or the kenotron part of it.

ELECTRICITY SUPPLY AND TRACTION AT MANCHESTER.

Reports for the Year 1922-23.

THE reports of both the electricity supply and tramway departments of the Manchester Corporation for the year ended March 31st last disclose eminently satisfactory results.

Electricity Supply.

The total revenue of the electricity supply department (of which Mr. S. L. Pearce, C.B.E., is engineer and manager) amounted to £1,394,625, comparing with £1,429,995. Against this was charged a working expenditure of £740,651, compared with £977,102, resulting in an increase in the gross profit from £452,893 to £653,974. Capital charges also increased, but not

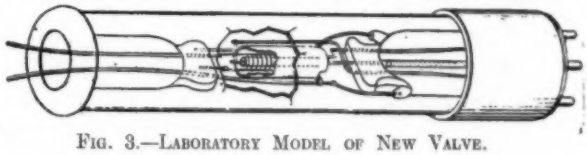


FIG. 3.—LABORATORY MODEL OF NEW VALVE.

to the same extent, and the net result was therefore a profit of £128,714—£84,150 more than in the previous year. The whole of the surplus was transferred to reserve. All interest and sinking fund charges arising during the year in respect of the new generating station at Barton, and high-pressure mains from the station, were met out of revenue. Further borrowing powers, amounting to £257,010, were secured during the year, and the capital expenditure amounted to £1,603,368, bringing the total outlay upon the undertaking up to £7,211,066.

The quantity of energy sold was 185,638,834 kWh, an increase of 17 per cent. upon the 1921-22 figure; the bulk of the

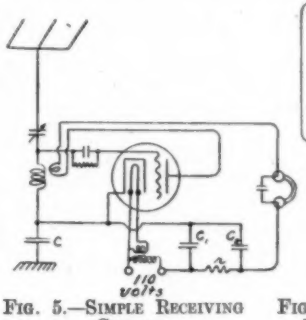


FIG. 5.—SIMPLE RECEIVING CIRCUIT.

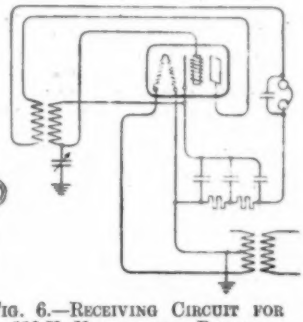


FIG. 6.—RECEIVING CIRCUIT FOR 110-V VALVE WITH POWER LINE ANTENNA.

increase is shown under the heading of "private consumers."

The average price of fuel fell by 12s. 4d. per ton to 22s. 11d. during the year, and the fuel consumption per kWh sold fell by 0.84 lb. to 2.6 lb. There was a striking contrast between the fuel costs at the Stuart Street station for the last two years. In 1921-22 the figure was £400,614, and last year it fell to £206,742. This remarkable reduction is attributed in large measure to improvements and economies in the boiler houses, causing the overall thermal efficiency to rise from 11.88 to 14.82 per cent. No additions were made to this or the City stations. A 1,800-kW turbo-generator and ten boilers were removed from Dickinson Street to make room for additional converting plant and the new 33,000-V distributing station building. A contract was placed with Messrs. Bruce Peebles and Co., Ltd., for two 2,500-kW motor-converters.

Notwithstanding the engineering lock-out in the early part of the year, very fair progress was made with the Barton station, which has enabled the first two generating sets, together with four boilers, to be put into commission this month (June).

A new station, equippped with two 2,500-kW motor-converters, was constructed during the year to provide d.c. to one section of the City area, and a temporary sub-station with 450 kW of converting plant was erected at Longsight; this will shortly be superseded by a permanent sub-station. An additional 1,500-kW motor-converter was installed in each of

the Polygon, Sherborne Street, and Knott Mill sub-stations. In addition to the new Longsight sub-station, the following are being constructed during the current year:—Great Ancoats Street, Chorlton-upon-Medlock, Hulme, Gorton, Denton, and West Didsbury; three of these will be fully automatic. In connection with the 33,000-V supply from the Barton station, the following new transformer distributing stations are under construction and were satisfactorily proceeded with:—High Street (25,500 kVA), Stuart Street (17,000 kVA), and Oldham Road "B" (18,000 kVA). The High Street station is the first completely-equipped outdoor sub-station operating at 33,000 V in this country. The Moss Side station was equipped with 33,000-V switchgear to deal with a supply from Barton. In addition to the foregoing, over 2,000 kVA of secondary plant was installed on the premises of six large consumers. During the year under review bulk supplies to the Sale and Cheadle Urban District Councils were furnished for the first time.

Callender's Cable & Construction Co., Ltd., satisfactorily completed its contract for the manufacture and laying of the 33,000-V cables forming the Barton transmission system. In all, a net addition of over 42 miles was made to the mains during the year, partly under contracts and partly by the department.

Tramways.

The accounts of the tramway department (general manager: Mr. Henry Mattinson) for the past year show a total revenue of £1,831,666 (including £1,813 net from the omnibuses), as compared with £1,994,577 (including £738 from omnibuses) in 1921-22. Working expenses amounted to £1,321,347, as against £1,519,838, leaving a gross profit of £510,319 (£474,739). To this was added £5,272 interest on investments, making £515,591, and capital charges absorbed £283,917 (£258,862), giving a final result of £231,674 profit, which was in advance of the previous year's net balance of £218,842. The capital expenditure increased by £96,469 to £2,828,832. The principal items of expenditure were rolling stock, £66,079, and permanent-way, £17,769. The number of passengers carried was 285,232,083, as compared with 278,869,773, and the number of car-miles run 20,289,399, as against 19,465,734. Nearly half of the passengers carried paid penny fares. During the year 32 new cars were put into service, including nine which were reconstructed in the department's workshops, and, in addition, seven single-truck cars and nine double-truck cars were reconstructed and fitted with vestibule ends. A great deal of reconstruction of the permanent-way was carried out in 16 streets, and special trackwork was renewed at 15 junctions.

ELECTRICITY SUPPLY AT SHANGHAI.

Report upon the Year's Working.

The Chief Engineer and Manager of the Electricity Department of the Shanghai Municipal Council (Mr. T. H. U. Aldridge, M.I.E.E., &c.) has sent us a copy of his report for the year ended December 31st, 1922, together with the accounts.

The revenue account records a total income from all sources of 7,253,158 taels, which, at the exchange rate of 1 Tael = 3s., gives a sterling equivalent of £1,087,974. Against this was charged a working expenditure of tls. 4,970,597 (£745,590), leaving a gross profit of tls. 2,282,561 (£342,384). After crediting certain sums and deducting capital charges there remained a net profit of tls. 1,221,806 (£183,271). In 1921 the net surplus amounted to tls. 1,047,608 (£157,141). The profit was allocated as follows:—To municipal funds, tls. 690,000 (£103,500), making a total contribution, since 1916, of tls. 2,860,000 (£429,000); to equalisation account, tls. 74,000 (£11,100); to general reserve, tls. 451,300 (£67,695); the balance being carried forward. The total capital outlay upon the undertaking increased during the year from tls. 20,771,469 (£3,115,770) to tls. 27,671,552 (£4,150,733).

The amount of energy sold was 232,457,361 kWh, an increase of over 47 million kWh, or 25.4 per cent. The total income per kWh sold fell from 1.32d. to 1.123d., and the total costs from .86d. to .77d. The plant capacity remained at about 84,000 kW, but the maximum demand rose from 43,554 to 53,950 kW. The load factor—51.5 per cent.—compared very favourably with that of the leading British undertakings, e.g., Manchester (21.65 per cent.), Glasgow (21.45 per cent.), and Birmingham (20.65 per cent.).

The report states that industrial conditions still affected electricity supply adversely, but in spite of this extensions should be proceeded with. The prospects for the future were very encouraging, although the present progress was not so rapid as it had been during the past few years.

No additional generating plant was put into service at the Riverside station during the year, but four new boilers were completed. Two of these were of the Babcock & Wilcox and two of the Stirling types, each having a normal evaporative capacity of 80,000 lb. of water per hour. Good progress was made with the extensions, which would bring the capacity of the plant to 121,000 kW by the end of the present year. Most of the concrete constructional work was completed, and the erection of the 20,000-kW Metropolitan-Vickers turbo-generator was well advanced. The two 3,000-kW house sets were practically completed and the 750-kW rotary converters were started up to supply d.c. to the fan motors and mechanical stokers in the new boiler house. The erection of the remaining six boilers was nearing completion at the end of the year. One bank of three 8,333-kVA transformers for stepping the generated pressure of 6,600 V up to 22,000 V for trunk distribution was put into use, and progress was made with the new 22,000-V switch house, wherein a considerable part of the switchgear was installed.

The old Fearon Road station was used to a smaller extent for generating purposes during the year, and had it not been for the traction load the generating plant could have been shut down entirely. The two 600-kW Ferranti cross-compound engine-generators were dismantled and sold. The new "super-sub-station" building at Fearon Road was practically completed, and much of the new 22,000-V and 6,300-V switchgear was erected.

It had been expected that the maximum load would reach 64,000 kW in 1922, and had anticipated new power consumers been connected earlier in the year, and had the flour mills been running, the maximum demand would not have been far short of that figure. There was little doubt that if the cotton-spinning industry had been as thriving as it had been

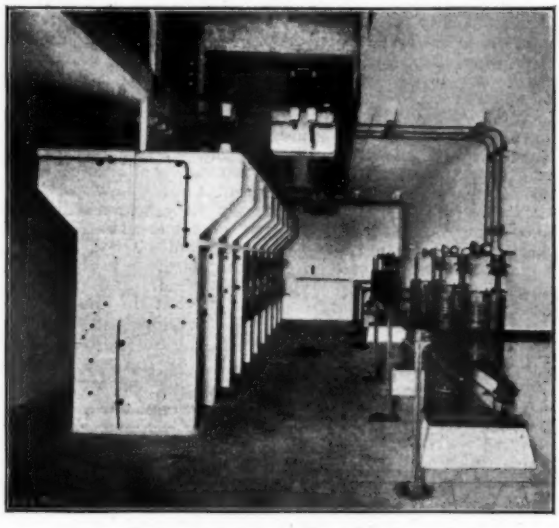


Fig. 1.—Interior of Kiaochow Road Sub-station, Shanghai.

in the past few years, greater efforts would have been made by the mill owners to get their new spindles into productive use, thus increasing the demand for electricity. The lighting and heating business continued to expand at a very satisfactory rate. Heating and cooking accounted for the consumption of 1,672,460 kWh, an increase of 27.48 per cent., and the demand for radiators again exceeded the supply. During the winter season 2,934 radiators were connected, and of these 2,128 were hired from the department. The total heating and cooking load was in the region of 7,500 kW. On the power side 771 motors, a total of 22,487 h.p., were connected, bringing the aggregate to 3,958 motors, representing 77,698 h.p. The loss of the flour-mill load during the year reduced the energy supplied to this particular industry from 21,303,833 kWh to 15,244,941 kWh.

The capital expenditure during the current year was estimated at tls. 2,722,141 (£408,321), and a net balance of tls. 1,398,950 (£209,843) was anticipated.

The accompanying illustration is reproduced from the report. It shows a new type of 6,300-V concrete switchboard and oxide lightning arresters in the Kiaochow Road sub-station.

An Automatic Hydro-Electric Station.—In the *Electrical World* of May 19th Mr. E. B. Collins states that the 5,000-kVA automatic hydro-electric generating station installed by the New England Power Co. has been running since June last year with satisfactory results. It is situated in a remote mountainous region, practically inaccessible during the winter months, and feeds through a 15-mile 66,000-V line the high-pressure busbars of another station. Very little trouble has been experienced with the automatic equipment, which is inspected at regular intervals. The lightning conditions are severe, and the high-pressure line has frequently been tripped out owing to lightning disturbances, but the generating plant has in every case promptly shut down, remaining stationary until the line has been energised from the other station, whereupon the plant has at once started running and resumed load.

EXTRA-HIGH-PRESSURE STEAM PLANT.

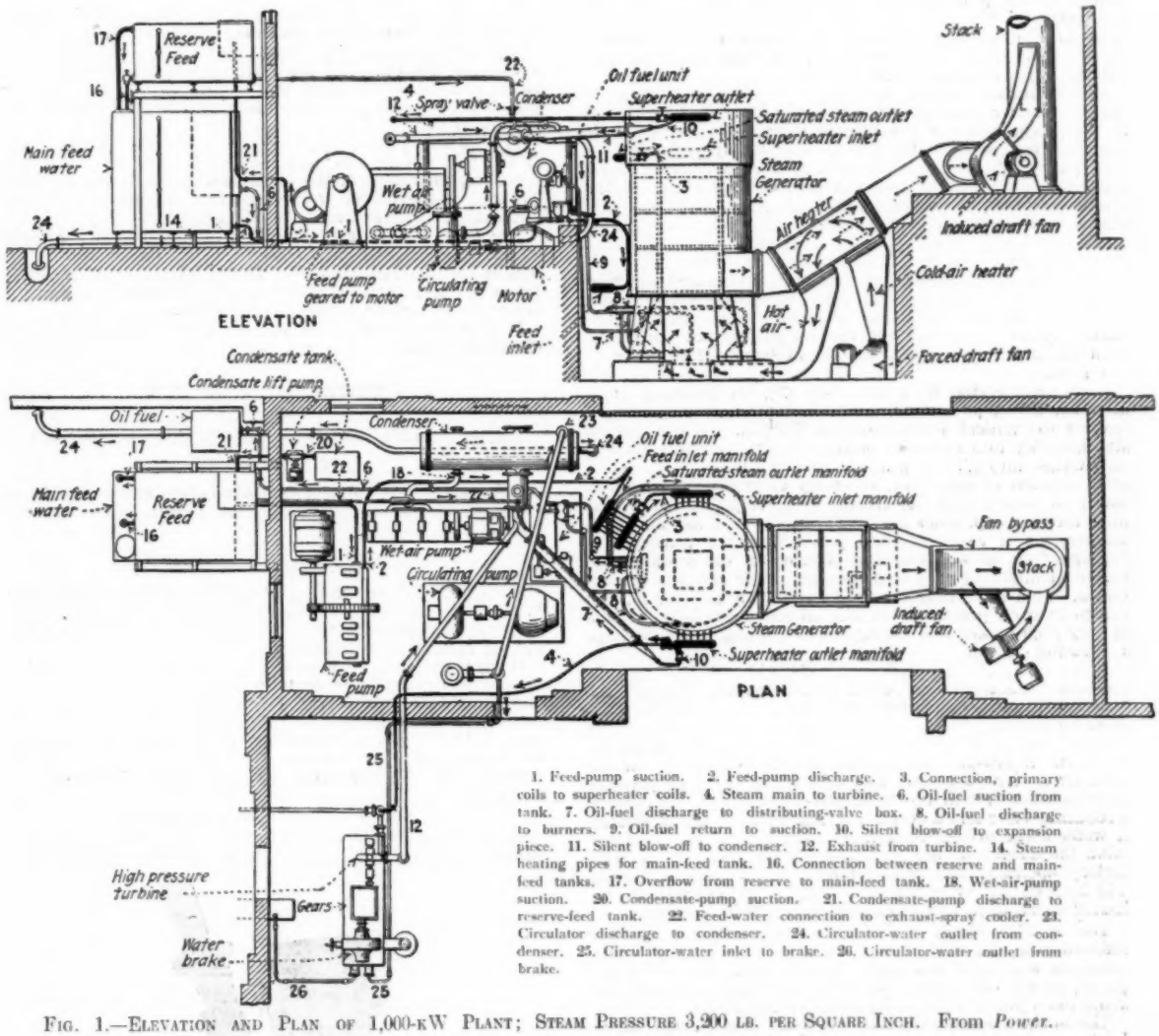
An extremely interesting account is given in *Power*, of May 22nd, of a 1,000-kW experimental test plant which is approaching completion at the works of the English Electric Co., Ltd., at Rugby. So far as we are aware no information regarding this installation has been published in this country.

Steam pressures up to 1,500 lb. per sq. in. have been successfully tried, but the present plant goes a long way further, using steam at a pressure of 3,200 lb. per sq. in. absolute, and at a temperature of 706 deg. Fahr. The choice of this pressure is due to the fact that this temperature and pressure correspond to a "critical point," at which water changes into steam, on the addition of heat, without change in volume. Thus there is no ebullition, and the trouble of priming, which has led to great difficulties in trials of pressures between 800 and 1,500 lb., is avoided. At the critical temperature no heat becomes "latent," and consequently the heating elements can be made of very small section, and without steam drums.

The designers are the Benson Engineering Co., Ltd., London, who, we understand, claim that the plant will consume about 28 per cent. less fuel than high-grade plant of the same capacity operating at 250 lb. per sq. in., and will also be cheaper to build and to maintain. The cost of the experimental steam generator, with feed pump and fan, is said to be less than that of a normal water-tube boiler of the same rating, though every part of it has been specially made; later sets should, therefore, cost less. Mr. M. Benson is the patentee. The steam generated at 3,200 lb. per sq. in. or more will be throttled down to 1,500 lb., superheated to 788 deg. Fahr., and passed through a turbine exhausting at 200 lb. per sq. in.; the exhaust steam will be re-heated to 662 deg. Fahr. and expanded in a turbine of normal type to a 29-in. vacuum.

A pound of water, occupying at 60 deg. Fahr. 0.016 cu. ft., at 706 deg. has a volume of 0.05 cu. ft., and is indistinguishable from steam; addition of heat then superheats it. At 706 deg. the total heat imparted to the water or steam is 908 B.th.u. per lb. In falling from that temperature to 100 deg. Fahr. the steam, if kept dry, expands to a volume 7,000 times greater than its initial volume, but it cannot be kept dry without large additions of heat, involving the supply of the same total heat at any temperature (saturated steam) as would be required if that stage had been arrived at in the ordinary way.

In the issue of our contemporary for May 29th the scientific basis of the system is discussed at some length, with the aid of the Mollier diagram. It is there stated that: "Feed water at a little above 3,200 lb. pressure is forced into the primary coils of the oil-fired steam generator. At a point about 90 per cent. through these coils the temperature of 706 deg. is reached, whereupon the water changes instantly to saturated steam of the same specific volume and total heat. In traversing the remaining 10 per cent. of the primary coils the steam is superheated to about 730 deg. Fahr. It next passes through a reducing valve, which brings the pressure down to 1,500 lb. and reduces the superheat almost to zero. The steam is then superheated to 788 deg. at 1,500 lb. in another set of coils and expanded to 200 lb. in a 464-h.p. high-pressure turbine. The exhaust is then re-heated to 662 deg. and then further expanded to ¼ lb. in a 1,210-h.p. low-pressure turbine. By employing the counterflow principle and using an air preheater operated by the flue gas, it is expected that a steam generator efficiency of 80 per cent. or better (not counting economiser or auxiliaries) will be obtained." It is assumed that the two turbines will utilise respectively 60 and 70 per cent. of the available heat drop, and assuming that the efficiency of the steam generator is 80 per cent., that of the alternator 95 per cent., and the consumption of the auxil-



1. Feed-pump suction. 2. Feed-pump discharge. 3. Connection, primary coils to superheater coils. 4. Steam main to turbine. 6. Oil-fuel suction from tank. 7. Oil-fuel discharge to distributing-valve box. 8. Oil-fuel discharge to burners. 9. Oil-fuel return to suction. 10. Silent blow-off to expansion piece. 11. Silent blow-off to condenser. 12. Exhaust from turbine. 14. Steam heating pipes for main-feed tank. 16. Connection between reserve and main-feed tanks. 17. Overflow from reserve to main-feed tank. 18. Wet-air-pump suction. 20. Condensate-pump suction. 21. Condensate-pump discharge to reserve-feed tank. 22. Feed-water connection to exhaust-spray cooler. 23. Circulator discharge to condenser. 24. Circulator-water outlet from condenser. 25. Circulator-water inlet to brake. 26. Circulator-water outlet from brake.

Fig. 1.—Elevation and Plan of 1,000-kW Plant; Steam Pressure 3,200 lb. per Square Inch. From *Power*. The path of feed water and steam is shown in solid black.

iaries 108 h.p. (fans 30 h.p., feed pump 56 h.p., condenser auxiliaries 20 h.p., oil pump 2 h.p.), the net over-all thermal efficiency of the plant would be 22.3 per cent.—much higher than that attainable in any commercial low-pressure plant of the same rating.

It appears that with saturated steam the point of theoretical best efficiency lies in the neighbourhood of 1,500 lb. pressure; in practice the best point would lie at a lower pressure. Assuming that the maximum permissible superheat temperature is 900 deg. Fahr., the best theoretical efficiency is found at 3,200 lb., but it is considered unlikely that a better result would be obtained in practice at that pressure than at 1,500 lb., owing to the greater fluid-friction losses. It will be seen, therefore, that the 3,200-lb. pressure has been chosen purely for the sake of generating the steam safely, cheaply, and economically. It is stated that the contract for the steam-generating coils has been awarded to a German company that has had long experience under similar conditions, and a sample of each tube has been tested by the National Physical Laboratory. The coils are all of carbon steel; the primary tubes have an inside diameter of 0.8 in. and an outside diameter of 1.2 in., while the superheater tubes, with the same bore, will have an external diameter of 1.6 in.

We reproduce from *Power* an elevation and plan of the plant under construction, which will be erected and tested at the Rugby works of the English Electric Co. Water from the main feed tank on the left hand is led by pipe 1 to the feed pump, which delivers it to pipe 2 at a pressure above 3,200 lb. Entering the feed manifold near the base of the steam generator, it passes up through five continuous coils encircling the interior of the generator. These coils are located in an annular space between the outer and inner walls, both of which are made of refractory material. The inner wall encloses the combustion space, the oil burners and air inlet being at the bottom, so that the gases rising in the centre position pass downward over the coils. This arrangement makes operation proceed on the counter-current principle, with the exit gases meeting the relatively cold feed water at the inlet.

As the water rises its temperature steadily increases until, after traversing perhaps 90 per cent. of the primary coils, it reaches the critical temperature of 706 deg. and changes instantaneously into saturated steam. During the remainder of its passage through the primary coils the steam acquires a small amount of superheat, necessary to provide a margin of safety to ensure that the critical point is passed before the fluid leaves the primary coils. The steam at 3,200 lb. and a temperature of about 730 deg. passes from the generator to the upper steam manifold and thence to the lower superheater manifold by way of a reducing valve and the connection 3. This valve throttles the steam down to 1,500 lb. and brings it back practically to the saturated condition (steam at very high pressure is not superheated when passed through a reducing valve).

In the test plant the slightly superheated steam at 1,500 lb. pressure is heated to about 790 deg. in passing through the superheater coils, and is then led through pipe 4 to the high-pressure turbine, which is of extremely small size, and is designed to give at least 464 b.h.p. when exhausting at 200 lb. absolute. A low-pressure turbine is not provided in the experimental plant, the performance of steam at 200 lb. pressure being sufficiently well known, so the exhaust is passed through a reducing valve and a de-superheating spray to the condenser. A water brake driven through reducing gear is used to determine the output of the high-pressure turbine. When satisfactory operation has been attained, a low-pressure turbine will be installed, to be fed with steam at 200 lb. pressure, reheated to 660 deg., and to exhaust into a 29-in. vacuum.

The smaller steam and fuel consumption will result in reduced size and cost of condensing and oil-burning equipment, as well as of the stack, draught fans, &c. The feed pump, on the other hand, will be more costly, and will consume more power than under ordinary conditions.

The burnt gases leaving the generator pass through an air heater, giving up much of their heat to the incoming air for combustion.

Provision is made for automatic devices to control the steam pressure and temperature, and the output of the feed pump; the superheater can be more or less completely shut off by dampers between the primary and secondary heating coils. The supply of air and fuel oil can also be automatically controlled, but as the test plant will operate under constant load, the automatic features will not be required in the first instance.

It is pointed out that the performance of such an installation cannot fairly be compared with that of one working at ordinary pressures on the basis of water consumed per kWh; the proper criterion is B.th.u. per kWh. Theoretically, the thermal efficiency of a perfect plant operating on the cycle used at Rugby would be 42.5 per cent., on the following assumptions: Feed temperature, 80 deg. F.; steam entering high-pressure turbine, 1,500 lb. and 788 deg.; exhaust pressure of high-pressure turbine and inlet of low-pressure turbine, 200 lb.; reheat to 662 deg. for low-pressure turbine inlet; exhaust at one-half pound.

An actual over-all plant thermal efficiency of 22.3 per cent. is expected by the designers, based on the following assumptions:—

Total steam generated per hour, lb.	10,000
Efficiency of steam generator without auxiliaries, per cent.	80
Part of available heat drop delivered as power at turbine shaft:	
High pressure, per cent.	60
Low pressure, per cent.	70
Efficiency of electrical generator, per cent.	95
Electrical power used by auxiliaries:	
Feed pump, h.p.	56
Draught fans, h.p.	30
Fuel oil, h.p.	2
Condenser, h.p.	20
Total, h.p.	108
Net output of plant	1,482 h.p. or 1,107 kW

A larger plant operating under the same conditions should give a much higher efficiency.

It is estimated that compared with ordinary 200-lb. plant, the complete installation (including condenser and electrical equipment) will cost 82 per cent., weigh 75 per cent., and have a thermal efficiency 135 per cent. The total hot-water and steam content of the plant will amount to about ¼ ton, and the steam main to the high-pressure turbine will have a bore of only 1¼ in.

The Benson patents are based on the generation of steam at the critical point, and are not restricted to the design and operating conditions of the experimental plant; nor are they confined to the use of water—mercury, sulphur dioxide, and solutions of solids in water, may be employed.

The experimental turbine will have only one small impulse wheel, rotating at from 20,000 to 25,000 r.p.m.; the steam will be expanded in the nozzle from 1,500 lb. down to 200 lb. pressure. Eventually it will be gear-connected to a standard low-pressure turbine running at 6,000 r.p.m.

It is expected that tests will be carried out during the current summer.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

"Invisible" Bell Wire.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C.2, has introduced a novel form of wiring for electric bells which appears to solve the question of unsightly wires, besides facilitating installation.

It takes the form of twin copper strips (5 × 120 mils) laid up between two felt paper tapes ⅜ in. wide. The insulation thus provided is ample, and the strip can safely be laid beneath floor coverings or wall-paper and entirely hidden from sight. If run on the surface it can be painted to match its background. The system would appear to be eminently suitable for burglar-alarm wiring, where invisibility is essential.

New Air-Break Knife Switches.

W. T. Henley's Telegraph Works Co., Ltd., Blomfield Street, London Wall, E.C.2, claims that the new air-break

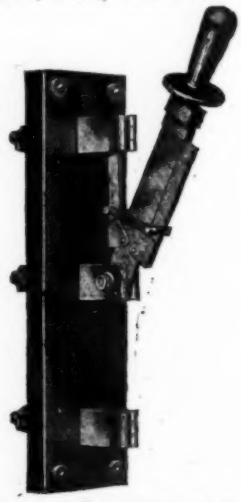


Fig. 1.—A "Henley" Double-throw Single-pole Knife Switch.

knife switches recently put on the market by the company are the first to conform with the British Engineering Standard Specification No. 109/1923. This specification provides, *inter*

alia, that a switch shall carry its rated current continuously with a temperature rise not exceeding 20 deg. C. for currents less than 100 A, and 30 deg. C. for currents of 100 A and above. Where switches are mounted on marble or slate slabs these must be free from metallic veins and other defects, and specially treated. Securing bolts must be insulated from the base, and special regulations are made governing the use of back connections.

The company makes these knife switches in a number of patterns. That illustrated in fig. 1 is the single-pole, double-throw pattern, with "flicker" blades, for use on 660-V circuits and rated to carry 200 A. The blades are so arranged that when the flicker breaks it is parallel with the edge of the break contact, thus minimising the effect of the arc. The bases are of black enamelled slate of best insulating qualities.

PARLIAMENTARY NOTES.

[By Our Special Parliamentary Reporter.]

Swanage Gas and Electricity Bill.—The Unopposed Committee of the House of Lords, over which the Chairman of Committees (the Earl of Donoughmore) presided, ordered this Bill to be reported for third reading on June 5th. It provides for the transfer of the undertaking of the Swanage Electricity Supply Co., Ltd., to the Swanage Gas Co., and for the change of name of the latter to the "Swanage Gas and Electricity Co." The area of supply comprises the urban district of Swanage and the parishes of Langton, Maltravers, and Studland (the three parishes being the added area under the Bill). The usual powers are given for the continuance of the existing generating station and the erection of a new one, subject to the approval of the Electricity Commissioners. A clause added since the introduction of the Bill gives the Minister of Transport the right to revoke the powers as to the supply of electricity in the added area of supply if suitable and sufficient distributing mains are not laid within three years from the transfer.

The Bill confers upon the company powers to raise an additional £40,000 by new ordinary or preference shares or stock, and it is provided that, with the consent of the Electricity Commissioners, further capital may be created and issued for the purpose of the electricity undertaking. The maximum dividend on the new ordinary capital is to be 8 per cent., unless a larger dividend is necessary to make up a deficiency on a previous dividend, and on the preference capital 7 per cent. Borrowing powers to the extent of one-half of the paid-up additional capital are included.

Oakham Gas and Electricity Bill.—The Unopposed Committee of the House of Commons considered this Bill on June 6th. Its object is to empower the Oakham Gas Co., Ltd., to supply electricity in its present area. Electricity is to be generated on the site of the existing gas works, by the use of gas engines. Owing to the fact that the generation of electricity and the manufacture of gas are to be combined, there is a clause in the Bill providing that if the local authority exercises its rights under the Electric Lighting Act to purchase the electricity undertaking it shall also purchase the gas undertaking.

Mr. SEDGWICK explained the provisions of Part II of the Bill, dealing with finance, which is to come into force three years after the company commences to supply electricity. Part II proposed the formation of an interest and dividend fund, the capital of the company to be allocated to separate accounts for the two undertakings.

Mr. SEABROOK, replying to questions as to why the electricity undertaking should not be bought separately by the local authority in 42 years if it desired, said that the gas works plant, which produced gas for supplying the ordinary consumers, would also produce gas for the engines driving the electricity plant, and if the electricity undertaking were separated from the gas undertaking, then the company would be left with idle plant, which had been used previously for the electricity undertaking. Again, the local authority would have to go to extra expense to provide plant for the electricity undertaking. After the Committee had discussed the matter privately, the Chairman announced that the Committee was willing, in this exceptional case, to pass the clause, but that it should be indicated in the preamble that the clause was allowed owing to the exceptional circumstances.

Leafield Wireless Station.—On June 5th, Mr. F. GRAY asked the Postmaster-General the purposes for which the Leafield wireless station was being used and the number of hours it was used daily; whether the hours of work could be so regulated that the working of the station did not interfere with broadcasting in the district; whether he was aware that the Poulsen arc transmission system in use at this station was making broadcasting in the district impossible: and whether any steps could be taken to remedy this by installing a modern valve circuit system or otherwise.

Sir L. WORTHINGTON-EVANS said that the Leafield station was engaged on important commercial services for upwards of eighteen hours daily, and it would not be possible to discontinue working during the broadcasting hours without abandoning some of those services. To reduce the interference as far as experiments were being carried out with the object of eliminating all emissions other than that on the fundamental wave length of the station.

In reply to Captain TERRELL, Sir L. WORTHINGTON-EVANS said a complete financial statement for the year ended March 31st last of the working of the Post Office wireless stations at Cairo, Leafield, Northolt and Stonehaven could not yet be furnished, but the following statement gave the estimated revenue and expenditure respectively during the year in question:—Cairo (open 11 months), £6,500, £45,000; Leafield (12 months), £31,200, £36,000; Northolt (7¼ months), £4,500, £5,500; Stonehaven (12 months), £3,500, £9,200.

Imperial Radio-telegraphy.—On June 5th, Sir H. BRITTAIN asked the Postmaster-General what action the Government had taken to give effect to the previously announced decision that licences should be issued to permit private enterprise to conduct wireless telegraph services with the Dominions, Colonies, and foreign countries; if the Government had considered the serious condition of things revealed in a return just issued by the Post Office of the high-power wireless stations possessed by the United States, France, Germany, and Great Britain; and whether, in view of the danger to the British Empire arising from the backward condition of Great Britain in high-power wireless telegraphy, he would say what action the Government proposed to take.

Sir L. WORTHINGTON-EVANS said that the conditions of the licences for which the Marconi Company had applied were being discussed with the company, and no time would be lost, so far as the Post Office was concerned, in arriving at a settlement. Meanwhile, the manufacture of the masts for the proposed Government high-power station was being proceeded with, and orders for the rest of the plant would be placed as quickly as possible.

On June 11th, Mr. ORMSBY GORE, Under-Secretary for the Colonies, informed Sir H. Brittain that it was contemplated that the question of wireless communications within the Empire should be considered in the first instance at the Imperial Economic Conference.

Broadcasting.—On June 5th, Sir L. WORTHINGTON-EVANS informed Sir C. Burn that he was considering in conjunction with the British Broadcasting Company what arrangements could be made for providing broadcasting facilities at or in the neighbourhood of Plymouth. Answering Sir W. DE FRECE, the POSTMASTER-GENERAL said that the licence to the British Broadcasting Company provided that the programmes of broadcast matter should be to the reasonable satisfaction of the Postmaster-General.

BRITISH SALES IN HOLLAND.

THE United Kingdom takes about one quarter of the value of Holland's exports, but she is a long way from supplying that proportion of Dutch imports. The latter totalled fl. 2,033,721,000 in value last year, Great Britain's share being only fl. 328,499,000. Under the heading, "Minerals and metals and manufactures thereof," United Kingdom exporters figure rather more prominently, for they supplied goods to the value of fl. 93,806,000 out of a total of fl. 362,126,000.

It is satisfactory to learn from H.M. Commercial Secretary's recent report on economic conditions in the Netherlands* that there is a growing tendency in that country to obtain supplies from English markets. He attributes this mainly to the gradual decline in the prices of British goods and to the simultaneous upward trend in quotations from countries with depreciated currencies and to the fact that manufacturers in such countries are constantly disappointing their customers by delays in delivery and the instability of their prices. There seems to be no doubt, he states, that on stabilisation or a rise of the mark, the Dutch market will be more open to British trade, which will have the advantage of firm quotations and steady deliveries. Promptness in carrying out orders will stimulate the Dutch buyer's activities, even though he may have to pay slightly higher prices.

The report as a whole does not give a very cheerful view of business prospects in Holland. As regards exports of farm and horticultural produce last year, there was a revival in live stock, butter and cheese were maintained, milk products fell heavily, whilst electric lamps remained steady. The Commercial Secretary does not consider immediate prospects to be good. A redeeming feature, however, is the dependence of Holland's prosperity on that of the Dutch East Indies, which has rich productive resources to offer to the whole world.

* Department of Overseas Trade. Price 2s.

H.M. Commercial Secretary mentions the completion last year of the first submarine telephone cable between England and the Netherlands and the report that negotiations are proceeding for the laying of a new Anglo-Dutch submarine cable.

During January, 1923, the wireless station at Kootwyk was for the first time able to get into touch with Malabar. This, however, is only possible for telegrams despatched after 3 p.m. from Holland, as these arrive during the night. Conditions in the morning render the transmission of telegrams impossible.

Since the late war underground telephone cables have been growing in importance, and up to the end of the year 251 kilometers had been laid between Amsterdam, The Hague, and Rotterdam, Utrecht and Dordrecht. There are 94 kilometres in course of completion, and a second cable between Amsterdam, The Hague, and Rotterdam has been ordered but not yet commenced. A cable between Roosendaal and Middelburg is at present being negotiated for, and the following routes are further projected :—

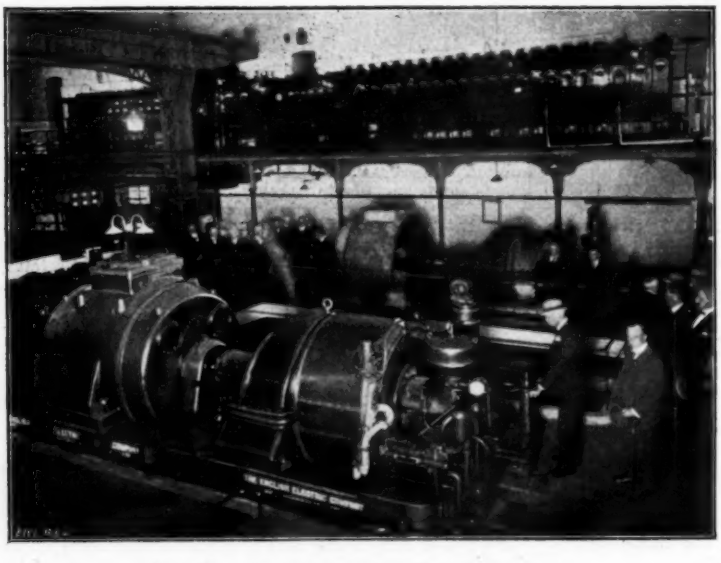
	Km.
Utrecht—Arnhem—German frontier	75
Utrecht—Zwolle—Mepel	125
Utrecht—Bois-le-Duc—Eindhoven	55
Tilburg—Eindhoven	20

The objective of this net of telephone cables is to link on to the German and Belgian systems, by which it is hoped to maintain communication with most of the western European countries.

AUSTRALIAN-BUILT TURBO-ALTERNATORS.

We have on previous occasions referred to the commencement of manufacture of various types of electrical apparatus in Australia, and by the courtesy of the English Electric Co. of Australia, Ltd., we are now enabled to reproduce a photograph of the first turbo-alternator built by the firm. The photograph was taken on March 26th, and shows the Chief Commissioner for New South Wales Government Railways (Mr. J. Fraser, C.M.G.) starting and putting on load a 2,500-kW turbo-generator at the Ultimo Power House, which supplies electricity to the Sydney tramway system for traction and lighting. After performing this office, the Chief Commissioner reviewed the progress of engineering generally and the power station in particular during the last 12 years, referring also to the advance from 1,500-kW turbines to the set which the English Electric Co. of Australia is now building for his department, of 18,750 kW capacity. Subsequently the Chief Commissioner, with the Chief Electrical Engineer and other well-known men, visited the Clyde Works of the company, and saw various heavy portions of the big set going through the shops.

The two sets seen in the illustration (one of which was in course of erection) are identical, with all parts interchangeable; each is rated at 2,500 kW and runs at 3,000 r.p.m. The steam turbine is of the impulse type, with one compound stage and six single stages, the steam entering at 160 lb. pressure per sq. in. and exhausting into a vacuum of 28½ in. of mercury.



The First Australian-built Turbo-alternator.

The alternator is directly connected to the turbine through a flexible coupling, and is of the 3-phase, 50-cycle type, working at 2,300 volts. A wet air filter is provided and a condenser with a cooling surface of 5,250 sq. ft., through which passes 4,550 gallons of sea water per minute. The air pump is of the centrifugal water-jet type, with centrifugal extraction pump, and is driven by a slip-ring induction motor. The weight of each complete set is about 100 tons, and practically the whole of the work, including the heavy castings, some of them 10 tons in weight, was carried out in Australia by the English Electric Co. of Australia, Ltd., to the drawings and designs of the English Electric Co., Ltd. The 18,750-kW set which the company has at present in hand is to be erected at the White Bay power house of the N.S.W. Railway Commissioners; it will be the largest electrical machine in the Commonwealth. The first tramway motors to be made in Australia are also being built by the company for the same purchasers.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Multiple Circuits.

Your leading article of last week on "Multiple Circuits" is of great interest, and we are in complete agreement as regards your contention that in these enlightened days it should be made possible to "plug in" small domestic appliances at any heating plug.

We have been working for some time past on the idea of devising an adapter to run a 5-ampere plug from a 20-ampere socket, combined with a 3 to 5-ampere fuse. We have a provisional patent for this article, and expect to place it on the market in a few weeks' time.

From this you will note that we do not agree with your second contention, *i.e.*, that there is no necessity to protect the apparatus so long as the circuit is safeguarded.

Apart from protecting the apparatus too, the 5-ampere fuse has the advantage of preventing unnecessary annoyance should the appliance which it is feeding develop a fault, as it would not cause other apparatus running off the same circuit to be put out of action (for the time) as would be the case if the circuit fuse were to blow.

It would give also a sense of confidence when running a vacuum cleaner, for instance, costing anything from £15 to £20.

For **"M.K." Electric, Ltd.**

London, *June 11th*, 1923. C. L. Arnold.

"Situations Vacant."

Under the heading, "Business Notes," on page 852 of your issue of June 1st you publish a letter from a "Satisfied Consumer" concerning your "Situations Vacant" columns.

I think it is fairly obvious that good men in their particular line will always find these columns a satisfactory means of obtaining an appointment, whereas second-rate men probably will not, for, generally speaking, it is the good men who get the jobs.

However, I feel sure that all those who have to seek situations through the medium of these advertisements will agree with me that it would be a very great improvement if advertisers would in all cases give some indication of the locality of their works or offices. A married man must think twice before moving some considerable distance unless he is going to obtain substantial improvement in salary or prospects, so why should he waste time writing for an appointment which he would not care to accept?

Again, there is the most important question of salary. Can nothing be done to induce employers to tell us plainly what salary they are willing to give instead of asking us, as is done in nearly all cases, to state the salary expected? Personally, I never have any objection to stating what I should expect; but I do strongly object to wasting time and money in writing for positions which would be of no use to me or which I could not hope to obtain.

May I appeal to you, Sirs, to use your influence to get these defects remedied, and, if I may offer a suggestion, it is that you should print each week at the head of the "Situations Vacant" columns a notice calling the attention of employers to the desirability of giving in their advertisements an idea of the locality and of the salary offered.

In time, I believe, such a note would have good results, and

would tend to correct a fault which is perhaps largely due only to the want of a little consideration on the part of the advertisers.

C. G. W.

June 6th, 1923.

[There is no doubt that many readers of advertisements of this description would appreciate the insertion of the particulars referred to by our correspondent. On the other hand, advertisers have their own views, and will act accordingly!—EDS. ELEC. REV.]

Meter Readings and Multiplying Factors.

With reference to the letter of "Secretary" in your issue of June 8th, a simple way out of his difficulty would be to get the Bastian Meter Co. to supply a new straight-line scale, calibrated for 220 volts, for each meter, and at his next reading of meters replace the 110-volt scales with these and set each meter at zero.

Bandon.

June 11th, 1923.

REVIEWS.

Text Book on Wireless Telegraphy. Vol. II. By RUPERT STANLEY. Pp. 394; 249 figs. London: Longmans, Green and Co. Price 15s. net.

In preparing the second edition of this well-known book the opportunity has been taken to effect a general revision and to make a number of additions necessitated by recent advances. As a matter of fact the development of radio signalling since the war has not been so rapid as might have been expected from the startling advances made during the preceding years. This, as the author points out, is probably due to the combined effect of economic conditions and the chaotic state of affairs which arose from the granting of patents during the war for apparatus and uses which were really covered by existing patents. The total progress during the past four years has, however, been considerable, and amongst the features of this edition there may be noted a new chapter in which modern valve apparatus is described at considerable length. In this field there has been and still continues such a flood of patents that it is difficult to sift the grain from the chaff, and difficult, indeed, to present the student with a reasonably concise treatment of what is undoubtedly "grain." The author selects for special consideration, as illustrating applications of the principles to which the volume is primarily devoted, the Marconi 3-kW valve transmitter, the Marconi receiver or tuner, and the Marconi valve and multi-valve amplifying detectors, local oscillation generator, and directional receiver; also, the Robinson direction finder, and the Radio Corporation's telephone transmitter for amateurs. Other valuable additions in various parts of the book are sections dealing with short-wave working (including the Armstrong method of super-audio-heterodyne reception), directional working, recorder reception and high-speed signalling.

Taken as a whole, the book constitutes an excellent treatise on the characteristics and uses of valves for transmission and reception, with brief notes on arc generators and high-frequency alternators and their uses. The author's wide and varied experience enables him to write with authority, and in the selection and presentation of subject matter the book leaves nothing to be desired. The treatment is non-mathematical except in certain important sections where an analytical treatment is added for the benefit of advanced students and research workers. The volume can safely be recommended as a text-book for students and practical workers, and as an inspiration to the remedying of the backward state (compared with America) into which, says the author, we have fallen as a result of economic difficulties, patent confusion, and lack of State enterprise. In the author's opinion the two outstanding problems for research are those connected with the elimination of atmospherics and with the invention of a cheap and rugged system of high-speed reception.

Wireless: Popular and Concise. By Lieut.-Col. C. G. CHETWODE CRAWLEY. Pp. 92; 25 illustrations. London: Hutchinson & Co. Price 1s. 6d. net.

The reader will expect much from an author who is Deputy Inspector of Wireless to the Post Office and Secretary to the Commission for planning the chain of Imperial wireless stations; and his expectations will be realised. Naturally it would be impossible, even if it were desirable, to go at all deeply into the subject in a book of this size, but there must be thousands of "listeners-in" who wish to know more than the mechanical routine of adjusting their sets, and to them and to others interested in the general principles and apparatus of modern "wireless" we recommend this inexpensive volume as a useful introduction to the subject. A concise and interesting review of the history of wireless is given first and the layman would do well to read this again, after he has gone through the book, for he cannot be expected to follow the technical allusions on a first reading. The chapter on wireless waves is scientifically accurate, yet it is built up from first principles, and illustrated with analogies with common knowledge concerning sound and light, so that it should be quite comprehended by the non-technical reader. How wireless messages are sent and received is what the average reader will be itching to know, and this he is told very simply, but withal accurately, in Chapters III and IV. A number of line diagrams and some excellent photographs supplement the letterpress.

In the next chapter, on wireless telephony, the author succeeds in explaining the principles of ordinary telephony in remarkably few words, and then goes on to show how the principles and apparatus of wireless telegraphy have been applied to the more exacting requirements of the transmission of speech. Stress is laid upon the phenomenal progress achieved during and since the war; the magnitude of the advance already effected, and the difficulties in the way of commercialising further developments which have already been made experimentally, are commonly under-estimated. An excellent chapter on wireless in ships is followed by one on the important subject of direction and position finding. A chapter on the Imperial wireless chain is followed by one on the eminently domestic question of broadcasting; and finally—full measure, pressed down, and overflowing—there is a very sound discussion of the relative merits and prospects of communication by wireless and wire. This small book is crammed with information, interesting, accurate, and clearly expressed.

Direct-current Machinery. By H. PENDER, Ph.D. Pp. x+314; figs. 146. London: Chapman & Hall. Price 15s. net.

There is now a fairly large output of books dealing with the theory and performance of electrical machinery, and merely touching on design. While this is an indication of the healthy growth of electrical engineering, and while a profound knowledge of design is essential for designers only, it must be carefully borne in mind that all engineers who have to deal with technical questions concerning electrical machinery ought to know at least how such machines should be designed. The book under review is not a treatise on design. The author, well known for his "Handbook for Electrical Engineers," wishes to provide a textbook on the theory and performance of direct-current machines for teachers and students in electrical engineering without going into design detail. We think he has succeeded. After treating fundamental principles, he passes on to discuss the elementary theory and construction. Commutation and armature reaction each fill a whole chapter; though, for our part, considering the influence of armature reaction on commutation, we should have considered reaction first. As an illustration of the care taken by the writer to make his subject-matter clear, it may be mentioned that the diagrams alone are almost sufficient for an intelligent reader.

Of the next two chapters on the voltage regulation of generators and on the operating characteristics of motors, it is hard to say which is the more useful—both are very good. Among miscellaneous d.c. machines, boosters, balancers, and third-brush generators are discussed. The last chapter—a fairly long one—is devoted to testing. Though here and there we have found faults there is little to which serious objection can be taken.

The book has two characteristics which we have been pleased to note in modern American treatises on electrical engineering—good illustrations and numerous examples.

X-Rays. By G. W. C. KAYE, O.B.E., M.A., D.Sc. Pp. xvii+320; figs. 124. London: Longmans, Green & Co. Price 16s. net.

The appearance of a fourth edition of this book is very opportune, since it has for some time been unobtainable. "It aims at giving an account of such present-day methods and apparatus as appears valuable or novel and which in many cases can only be found scattered throughout many journals." This aim is well realised, and not the least valuable feature of this book are the very extensive references (amounting to several per page) to the original sources, both English and Continental.

In his preface the author trusts the book will be acceptable, alike to students of physics, to the man of general scientific interests, and particularly to the members of the medical profession. To the two former classes the book may be strongly recommended as giving a concise but very complete account of our present knowledge of X-radiation. The medical reader may, however, find difficulty in the high standard of physics demanded for a full appreciation of the book (Plancks Quantum Hypothesis, &c.), but to those who are interested in the physics, as well as the therapeutical aspects, of X-rays this is doubtless the best book on the physics of X-rays in the English language.

A chapter entitled "Practical Applications of X-Rays" describes the use of X-rays for the examination of aeroplane castings, welding, the supervision of optical glass manufacture, &c., and follows very closely the more recent book by the author of similar title.

The book is well illustrated, but is not printed on as good paper as the older editions.

B. J. L.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

12,793. "Thermionic valve holder." O. W. Walker. May 25th.
12,795. "Cable drums." A. G. Brown. May 25th.
12,859. "X-ray tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. May 25th. (Holland, December 6th, 1922.)
12,856. "Electric light signs." A. E. Field. May 25th.
12,857. "Ohmic resistances." P. Bouret and P. Ledreux. May 25th.
12,859. "Radio-telephony." Marconi's Wireless Telegraph Co., Ltd. May 25th. (United States, May 26th, 1922.)
12,864. "Electric furnace for heating drill steel, &c., tools." D. F. Campbell. May 25th.
12,869. "Detection and reception of sounds, &c." H. Kirschfeldt. May 25th.
12,880. "Thermionic valve arrangements." E. A. Graham and W. J. Ricketts. May 25th.
12,882. "Light operated controllers." E. H. Medén. May 25th. (United States, May 25th, 1922.)
12,886. "Tester for wireless circuits." H. Constable and K. Secretan. May 26th.
12,887. "Selectivity apparatus, &c., for wireless telegraphy, &c." A. Dinsley and F. H. Henri. May 26th.
12,921. "Electric welding and annealing apparatus." Western Electric Co., Ltd. May 26th. (United States, August 31st, 1922.)
12,929. "Telephone mouthpieces." Bailey, Plant & Co., Ltd., and W. A. Bailey. May 26th.
12,931. "Electric incandescent lamps." A. Mullor. May 26th. (Spain, May 26th, 1922.)
12,936. "Electric transforming apparatus." J. E. Calverley and W. E. Highfield. May 26th.
12,950. "Electric contact or terminal." A. E. Chapman. May 26th.
12,953. "Wireless signal systems." J. Henderson. May 26th.
12,960. "Dynamo-electric generators." J. H. St. H. Mawdsley. May 26th.
12,964. "Electric cut-out devices." G. W. Mascord. May 26th.
12,965. "Railway signalling systems." Automatic Telephone Manufacturing Co., Ltd. May 26th.
12,967. "Electrolytic separation." B. E. F. Rhodin. May 26th. (United States, May 26th, 1922.)
13,970. "Telephone receivers." J. W. Hobley. May 28th.
13,974. "Geared commutator or distributor for internal-combustion engines." A. Mann and V. Wright. May 28th.
13,987. "Shield for wireless valves." M. W. Lawrence. May 28th.
14,000. "Electric distribution board." J. F. Wright. May 28th.
14,021. "Crystal, &c., detectors for wireless telegraphy, &c." S. S. Austin and C. F. Ladd. May 28th.
14,026. "Electric batteries." H. M. Genese, W. Peto, and Pritchett and Gold & E.P.S. Co., Ltd. May 28th.
14,028. "Electrically-operated oil cups." R. R. McClure. May 28th.
14,045. "Electrolytic processes." W. J. Jackson (Mathieson Alkali Works Inc.). May 28th.
14,056. "Variable inductances." H. McClelland. May 28th.
14,060. "Galvanic batteries." L. Fuller and Fuller's United Electric Works, Ltd. May 28th.
14,081. "Telephonic receivers." E. A. Graham. May 28th.
14,089. "Wireless selective controller for radio transmitters." A. G. L. Pennock. May 28th.
14,099. "Safety catches for electric lifts." W. T. Beale. May 29th.
14,113. "Electric fittings for pendants, switch plugs, &c." F. Rawnsley. May 29th.
14,115. "Crystal detectors for wireless receiving apparatus." A. Harrison. May 29th.
14,118. "Illuminated signs, &c." I. Jascourt, H. D. Pattinson, J. Rose, and Seal Co. (London), Ltd. May 29th.
14,119. "Illuminated signs, &c." I. Jascourt, H. D. Pattinson, J. Rose, and Seal Co. (London), Ltd. May 29th.
14,122. "Radio-telegraphic, &c., variometers, &c." S. P. Shaw. May 29th.
14,123. "Tuning-device for wireless receiving apparatus." A. A. Lawrence. May 29th.
14,124. "Crystal detectors." H. W. Halsey. May 29th.
14,130. "Interference eliminator for telegraphic, &c., apparatus." A. W. Sharman. May 29th.
14,132. "Instantaneous switch." R. O. Kapp (Scherbius & Ritter). May 29th.
14,135. "Device for suspension of electric light bowls, &c." D. Blondiaux. May 29th.
14,150. "Renewable primary dry cell batteries." W. S. Doe. May 29th.
14,152. "Electric circuits for motor electric cars, &c." E. J. Ondoli. May 29th.
14,171. "Regulating degree of vacuum in X-ray tubes." British Scientific Instrument Research Association, Sir H. Jackson, and A. J. Philpot. May 29th.
14,177. "Wireless receiving apparatus." F. Pascall. May 29th.
14,182. "Telephone receiver." H. W. Parker. May 29th.
14,183. "Telephone plug-holder." H. W. Parker. May 29th.
14,184. "Sound-producing diaphragm." H. W. Parker. May 29th.
14,194. "Regulating resistances and switches therefor." T. Houghton. May 30th.
14,213. "Terminal." H. H. Ganney and L. F. Richardson. May 30th.
14,217. "Synchronisation of machines for recording and reproducing sounds and movements." C. H. Verity. May 30th.
14,226. "Wireless transmitter." H. J. Farrell. May 30th.
14,231. "Electric switches." R. C. Minton and A. Reyrolle & Co., Ltd. May 30th.
14,244. "Radio-broadcasting equipment." Western Electric Co., Ltd. May 30th. (United States, June 9th, 1922.)
14,245. "Taping machines." Western Electric Co., Ltd. May 30th. (United States, August 31st, 1922.)
14,254. "Dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). May 30th.
14,270. "Means for testing faulty electric line insulators, &c." O. W. Brain. May 30th.
14,277. "Pressure rheostats." Reliance Co. May 30th. (United States, July 13th, 1922.)
14,288. "Sound-reproducing machines." W. T. Forse. May 30th.
14,291. "Rotor bearings of electricity meters." Ferranti, Ltd., and S. Z. de Ferranti. May 30th.
14,299. "Interrupters for wireless telegraphy, &c." W. F. Bubb. May 30th.
14,311. "Methods of jointing electric cables." A. M. Taylor. May 31st.
14,313. "Electric power transmission by underground cables." A. M. Taylor. May 31st.
14,317. "Inductance coils for wireless receiving sets." W. H. Collins. May 31st.
14,346. "Apparatus for evaporation of liquids by electrical energy." P. H. Dawe. May 31st.
14,353. "Wireless receiving circuits." W. J. Polydoroff. May 31st.
14,361. "Wireless set combined with gramophone cabinet, &c." B. Asserson. May 31st.
14,362. "Control of trains." A. R. Angus. May 31st.
14,368. "Production of arc-light electrodes." Rütgerswerke Akt. Ges. May 31st. (Germany, June 9th, 1922.)
14,371. "Supplying electric power to railways, &c." Sir P. Dawson and F. W. Fawdry. May 31st.
14,373. "Transformation of current on electric railways, &c." F. W. Fawdry. May 31st.
14,375. "Sound recording and reproducing instruments." W. E. Clifton and F. Kay. May 31st.
14,378. "Automatic voltage regulator." M. Kinoshita. May 31st.
14,379. "Electric generators." J. Burke. May 31st. (United States, June 15th, 1922.)
14,395. "Electric furnaces." L. H. Paddle. May 31st.
14,397. "Automatic reclosing circuit-breakers." British Thomson-Houston Co., Ltd. May 31st. (United States, June 5th, 1922.)
14,399. "Protective apparatus for alternating-current systems." British Thomson-Houston Co., Ltd., and A. S. FitzGerald. May 31st.
14,402. "Radio-receiving apparatus." D. McErlane. May 31st.
14,409. "Combined portable electric heater and lamp." P. Rombach. May 31st.
14,410. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., R. Mercer, and F. Tench. May 31st.
14,429. "Operating mechanism for switch, &c., gear for electric motors." L. E. Wood. June 1st.
14,432. "Magnetic and electro-magnetic thrust bearings, &c." H. G. Harley. June 1st.
14,452. "Switches for electric welding machines." E. Schröder. June 1st.
14,459. "Electric terminal." L. A. Pristow. June 1st.
14,461. "Method of tuning coils for wireless receiving sets, &c." J. W. Bonfield, W. J. Eade, and G. M. Southam. June 1st.
14,468. "Controlling thermionic valves." M. Child. June 1st.
14,484. "Moulds for reactance coil supports." Metropolitan-Vickers Electrical Co., Ltd. June 1st. (United States, June 16th, 1922.)
14,485. "Microphone transmitters." Fuller's United Electric Works, Ltd., and A. P. Welch. June 1st.
14,516. "Automatic telephone systems." T. Lenaghan. June 1st.
14,524. "Automatic telephone systems." T. Lenaghan. June 2nd.
14,548. "Wireless valves." F. G. Ride and C. Tucker. June 2nd.
14,554. "Acoustic signalling." W. A. Loth and Soc. Industrielle des Procédés W. A. Loth. June 2nd.
14,556. "Crystal rectification device." W. S. Worthington. June 2nd.
14,560. "Electric sub-station systems." Metropolitan-Vickers Electrical Co., Ltd., T. W. Ross, and A. F. Thompson. June 2nd.
14,561. "Vacuum electric tube devices, &c." Metropolitan-Vickers Electrical Co., Ltd., E. A. Ollard, and E. Y. Robinson. June 2nd.
14,566. "Wireless apparatus." G. F. Oatins and J. F. Smith. June 2nd.
14,582. "Devices for advertising, &c., signs." Franco-British Electrical Co., Ltd. June 2nd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

34,540. "Prepayment devices for telephone systems." Siemens Bros. and Co., Ltd., J. E. Collyer, and R. Barker. December 22nd, 1921. (197,711.)

1922.

4,157. "Impermeable electric apparatus, such as incandescent lamps, vacuum apparatus, gas-filled apparatus, and the like." F. H. L. Holweck. February 11th, 1921. (175,291.)
4,203. "Alternating-current commutator machines." F. Creedy. February 13th, 1922. (197,722.)
5,523. "Electrically-operated mining plant." J. F. Perry, A. Stubbs, and Metropolitan-Vickers Electrical Co., Ltd. February 24th, 1922. (197,753.)
5,801. "Carrier-wave transmission systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). February 27th, 1922. (197,758.)
5,842. "Electric switches." R. A. Macaulay. April 26th, 1922. (197,759.)
5,947. "Apparatus for the production of cipher documents especially adapted for telegraphic dispatch." H. G. C. Fairweather (Aktiebolaget Crytograph). February 28th, 1922. (197,763.)
6,587. "Oil-cooled electron discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.). March 6th, 1922. (197,774.)
6,862. "Means for converting a direct or unidirectional electric current into a high-frequency alternating current." P. d'Aigneaux. March 8th, 1922. (197,782.)
7,623. "Systems of control for lifts." J. Lyons & Co., Ltd., A. Goddard, and G. Douglass. March 15th, 1922. (197,790.)
8,598. "Telephone systems." Western Electric Co., Ltd., and L. Polinkowsky. March 24th, 1922. (197,797.)
8,807. "Microphones." E. D. Young. March 27th, 1922. (197,799.)
11,976. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. April 28th, 1921. (Addition to 165,031.) (179,188.)
12,711. "Advertisement and similar display apparatus with moving and changing effects." H. F. E. S. Dusseris. May 5th, 1922. (197,828.)
15,048. "Telephone and like receivers." E. S. Pridham and P. L. Jensen. May 29th, 1922. (197,836.)
15,351. "Dry batteries." Soc. Anon. Le Carbone. May 1st, 1922. (196,878.)
17,232. "Thermionic valves." W. R. Bullimore. June 22nd, 1922. (197,853.)
17,481. "Intervalve and telephone transformers for use in wireless receiving apparatus." C. F. Elwell and B. E. G. Mittell. June 24th, 1922. (197,854.)
17,678. "Alternating-current electric motors." E. Weissberg. July 1st, 1921. (182,468.)
18,028. "Method of and apparatus for electrical precipitation of suspended particles from gaseous fluids." Lodge-Cottrell, Ltd. (E. Anderson). June 30th, 1922. (197,857.)
18,443. "Sparking plugs for internal-combustion engines." E. E. E. Doue. July 5th, 1922. (197,862.)
18,735. "Electric resistance device." Ward Leonard Electric Co. and A. E. Waller. July 7th, 1922. (197,864.)
19,030. "Electric switch." J. B. McDowell. July 11th, 1922. (197,867.)
19,143. "Dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). July 12th, 1922. (197,870.)
20,040. "Multiple-range electric current transformer." Landis & Gyr Akt. Ges. July 22nd, 1921. (183,480.)
21,372. "Circuit breakers." British Thomson-Houston Co., Ltd. August 4th, 1921. (184,194.)
24,273. "Electric time switches." Landis & Gyr Akt. Ges. September 7th, 1921. (185,751.)
24,809. "Electric alarms." L. J. Dabos. September 14th, 1921. (186,061.)
25,283. "Negative electrodes for electric accumulators." C. Gross. October 17th, 1921. (187,584.)
26,206. "Process for the electrolytic separation of pure chromium in thick layers." G. Brewer (F. Krupp Akt. Ges.). September 28th, 1921. (197,887.)
26,790. "Electric clock." A. B. Härje. October 4th, 1922. (197,888.)
32,634. "Telephone systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). November 29th, 1922. (197,891.)

1923.

3,335. "Multiple-contact panels for luminous signboards." E. Marre. February 4th, 1922. (192,709.)
3,527. "Device for rupturing electric arcs." Forges et Ateliers de Constructions Electriques de Jeumont. February 20th, 1922. (184,273.)